INTEGRATING GROUP DELPHI, FUZZY LOGIC AND EXPERT SYSTEMS FOR MARKETING STRATEGY DEVELOPMENT: THE HYBRIDISATION AND ITS EFFECTIVENESS

Shuliang Li and Barry J. Davies
Gloucestershire Business School, Cheltenham & Gloucester College of Higher Education, Cheltenham, UK.

John S. Edwards
Aston Business School, Aston University, Birmingham, UK

Russell Kinman and Yanqing Duan
Luton Business School, University of Luton, Luton, UK

Abstract

A hybrid approach for integrating group Delphi, fuzzy logic and expert systems for developing marketing strategies is proposed in this paper. Within this approach, the group Delphi method is employed to help groups of managers undertake SWOT analysis. Fuzzy logic is applied to fuzzify the results of SWOT analysis. Expert systems are utilised to formulate marketing strategies based upon the fuzzified strategic inputs. In addition, guidelines are also provided to help users link the hybrid approach with managerial judgement and intuition. The effectiveness of the hybrid approach has been validated with MBA & MA marketing students. It is concluded that the hybrid approach is more effective in terms of decision confidence, decision quality, group consensus, coupling analysis with judgement, etc.

Keywords: group decision-making, group Delphi, fuzzy logic, expert systems, intelligent hybrid systems, decision support systems, marketing planning, marketing strategy

1. Introduction

Marketing strategy development is the process of devising the means of utilising the company's resources to achieve marketing objectives. The use of computer-based support systems for marketing strategy development and strategic marketing planning has attracted interest from many researchers. A summary on typical research in this field is given in Table 1. Extensive literature reviews on previous work in this field may be found in Li (2000a) and Li et al. (2000).

Table 1. A summary on typical research on computer-based support for strategic marketing planning

Type of system or technique	Typical research and author(s) in this field
Decision support systems (DSS)	A prototype of a decision support system for strategic planning (Moormann and Lochte-Holtgreven, 1993). A strategic decision support system for validating actual strategies or formulating strategies (Belardo et al., 1994)
Expert systems (ES)	A prototype of an expert system for strategic marketing planning (McDonald and Wilson, 1990). An expert system for strategic management (Carlsson et al., 1996)
Fuzzy logic	Using fuzzy logic for global market entry analysis (Levy and Yoon, 1995)
Artificial neural networks (ANN)	Using artificial neural networks for analysing market share using the profit impact of market strategy (PIMS) database (Poh, 1994). Incorporating neural networks in conjunction with portfolio matrices to help evaluate and formulate strategic plans (Chien et al., 1999)
Intelligent agents	An experimental prototype of a multi-agent system for strategic planning (Pinson et al., 1997)
Hybrid systems that integrate more than one intelligent techniques	Combining the analytic hierarchy process with an expert system for marketing planning (Duan and Burrell, 1995); Hybridising artificial neural networks, fuzzy logic and expert systems for developing marketing strategies (Li, 2000a); Using fuzzy logic and expert systems for developing global strategies and associated Internet strategies (Li and Davies, 2001)

It is argued that individual support systems or techniques have their own strengths or weaknesses (Goonatilake and Khebbal, 1995). Individual techniques or systems can only fit specific aspects of strategic marketing decision-making. A discussion of the powers and limitations of relevant support systems or techniques may be found in Li et al. (2000) and Li (2000a). An intelligent hybrid approach is a way that integrates the advantages of different conventional and intelligent support techniques or technologies while avoiding their disadvantages.

In this paper, a hybrid approach for integrating group Delphi, fuzzy logic and expert systems for developing marketing strategies has been proposed and developed by the first named author. The structure of the paper is organised as follows. The underlying principles and relevant techniques of the hybrid approach are explained in Section 2. In particular, the specified group Delphi process for SWOT analysis, the fuzzification of strategic inputs and the use of expert system rules for formulating marketing strategies are discussed in this section. Guidelines on how to link the hybrid approach with managerial judgement and intuition are also provided in Section 2. Evaluation of the effectiveness of the hybrid approach is reported in Section 3. Conclusions are given in the final section.

2. The Hybrid Approach

According to the mail questionnaire survey findings reported by Li et al. (2000), of the 104 responding companies, 42 companies reported that two or more (even four or five in some cases) directors of their companies had principal responsibility for the development of marketing strategies. While this finding suggests that shared responsibility among directors is quite common in the process of marketing strategy development, there could be more people participating or involved in the process. Eden (1990) points out that those who have the power to act must be integrally involved in developing strategies, Porter (1987) also argues that strategic planning should employ multifunctional planning teams. It is argued that group decision support can be used to improve the effectiveness of group decision-making (DeSanctis and Gallupe, 1987). Therefore, group decision support techniques may be useful in support of groups of managers in developing marketing strategies.

Senior managers also perceive the strategy development process as involving a high degree of uncertainty and ambiguity (Li et al., 2000). It is evident that one principal factor leading to managerial dissatisfaction is the systems' inability to deal with uncertainty (Li et al., 2000). Brownlie and Spender (1995) argue that uncertainty and ambiguity is an important issue in strategic marketing decisions. Levin et al. (1995) argue that marketing decisions are subject to multiple sources of uncertainties and contain fuzzy issues. Levy and Yoon (1995) point out that fuzziness, imprecise measures and uncertainty for strategic factors all affect marketing decision-making. Fuzzy logic is a technique which is designed to cope with imprecise linguistic concepts or fuzzy terms (Zadeh, 1988). Fuzzy logic allows users to provide inputs in imprecise terms and receive either fuzzy or precise advice. The technique can also be applied to model the imprecise modes of reasoning (Zadeh, 1988; Goonatilake and Khebbal, 1995; Li, 2000b).

It is also evident that many managers lack knowledge and skills in developing marketing strategies (Li et al., 2000). McDonald (1989b), McDonald and Wilson (1990) and Li (2000b) note that expert systems can offer domain knowledge for some key aspects of the key stages of marketing strategy development.

Mintzberg (1994a, 1994b, 1994c) argues that strategic planning must be coupled with managers' intuition and judgement about their products, customers and markets to ensure the best of human thinking. According to the mail survey findings by Li et al. (2000), many managers reported that their intuition and judgement are important in strategy development. Hence, managerial judgement and intuition should be an integral part of the strategy development process (Li et al., 1999).

In order to support the process of marketing strategy development effectively, the strengths of different support techniques should be integrated. The driving forces for using a hybrid approach are: to achieve techniques enhancement because we want to avoid the weaknesses of individual techniques while combining their strengths; and to achieve multiplicity of application tasks because no single technique is adequate to deal with the many sub-problems of the given task.

There are several technical strategies for achieving the hybridisation (Goonatilake and Khebbal, 1995): the development of stand-alone models, intercommunicating models, function-replacement models, and polymorphic models. The intercommunicating method is used because it is flexible and relatively easy to implement. The intercommunicating method is particularly useful if we want to achieve multiplicity of application tasks by using different support techniques or technologies.

In this study, an intelligent hybridisation is achieved by using the intercommunicating method (Goonatilake and Khebbal, 1995). Within this hybrid approach, a group Delphi process is specified for SWOT analysis. Fuzzy logic is applied to fuzzify the results of SWOT analysis. The expert system technology is employed to undertake intelligent reasoning for setting marketing strategies. In addition, managerial judgement and intuition are also incorporated into the strategy development process. A framework for the hybrid approach is given in Table 2. A logical diagram for the hybrid approach is illustrated in Figure 1.

Table 2. A framework for the hybrid approach

Strategy development process	**System or technique**	**The strategy-maker**
SWOT analysis	Group decision support techniques	Experience, judgement and intuition
Portfolio summary & setting strategies	Fuzzy logic, expert systems	

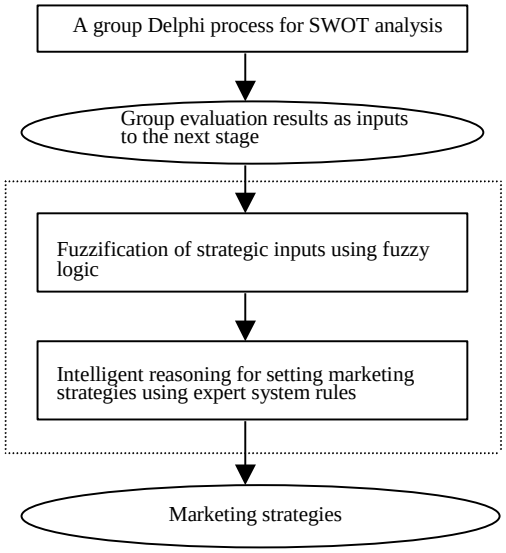

Figure 1. The architecture of the hybrid approach

2.1 A specified group Delphi process for SWOT analysis

Over the past 40 years, many group decision support techniques or systems have been developed to support group decision making. Some of them include the nominal group technique (NGT) (Lindstone and Turroff, 1975), the Delphi method (Dalkey and Helmer, 1963; Lindstone and Turroff, 1975; Turban, 1995), the group Delphi method (Webler et al., 1991), decision room GDSSs (DeSanctis and Gallupe, 1985), local decision network GDSSs (DeSanctis and Gallupe, 1985), teleconferencing GDSSs (DeSanctis and Gallupe, 1985), remote decision making GDSSs (DeSanctis and Gallupe, 1985), strategic options development and analysis (SODA) (Eden, 1990), and many other forms of group decision support (Mockler and Dologite, 1991; Jessup and Kukalis, 1990; Aiken et al., 1994, 1995; Gear and Read, 1993), etc.

In this study, a group decision support process is specified to support the SWOT analysis phase of marketing strategy development within the framework shown in Table 2 and the logical diagram illustrated in Figure 1. The specified process is based on the group Delphi method (Webler et al., 1991), with the extension in a structured

step-by-step group process and with the focus on SWOT analysis. The group Delphi process is presented below:

Step 1. Establish the issue - SWOT analysis for marketing strategy development

In a reserved decision room, the group moderator introduces the group Delphi process and establish the task of SWOT analysis for marketing strategy development. The analysis of external opportunities and threats should be linked to the assessment of market attractiveness. Therefore, the assessment of opportunities and threats should focus on, but should not be limited to, such factors as industrial competition, market size, market growth rate, market vulnerability, etc. (Day, 1984, 1986; McDonald, 1996). Industrial competition can be assessed using Porter's five forces model (Porter, 1980a, 1980b). Factors related to opportunities and threats can be arranged under the heading of the attractiveness of the market concerned.

The analysis of a company's or a strategic business unit's strengths and weaknesses should be linked to the assessment of business strengths. Therefore, the judgement on competitive strengths and weaknesses should focus on, but should not be restricted to, market share, product fit to customer requirements, product quality, price competitiveness, general image, services for customers, etc. (Hax and Majluf, 1983a, 1983b; Day, 1984, 1986; McDonald, 1996). Factors related to competitive strengths and weaknesses can be arranged and summarised under the heading of business strengths.

The group members then review the above-mentioned criteria or factors with the aid of a PC connected to a multi-media projector. They also check whether anything important has been missed or something unimportant or irrelevant has been included. If there is any disagreement on the factors considered, then debate and discussion should continue until consensus is reached. If the disagreement persists, a voting procedure may be used to determine the criteria.

Step 2. Obtain inputs from the group members

Participants of the group should be divided into several small subgroups at this stage. Each of the participants is given a data form or questionnaire and asked to input their judgement and intuition about each factors under specified headings. Gear and Read (1993), and Read and Gear (1994) proposed various methods for the inputs of managerial judgement and intuition: direct assessment, comparison, scoring and voting. In this study, scoring method is used to evaluate each of the set of factors on a pre-defined scale ranging from 1 to 10 or abstain. Participants are also asked to judge or weight the relative importance of each factor concerned (the relative importance ranges from 0 to 1 or abstain. A detailed discussion on the method for scoring and weighting strategic factors may be found in McDonald (1989a). Inputs are entered in the form of numbers using closed-ended questions.

At this stage, a voting procedure may be used to resolve differing views on the inputs among the subgroup members.

Step 3. Record, analyse the inputs and provide a display of the responses back to the group members

Inputs from each subgroup are then collected and processed by the moderator. The moderator then records and summarises the inputs using a PC. The results are then displayed using the multi-media projector that is connected to the PC. The display should show the subgroups' inputs to each factor and the differences between the different inputs.

Step 4. Stimulate debate of principal points of agreements and disagreement

Arrow (1951) argues that there is no a general method of aggregating consistent individual preferences into a single consistent group preference function with reasonable properties. A method for dealing group decision-making involves acceptance of disagreement and a willingness by group members to compromise individual preferences in favour of group preference. This requires good communication between group members and feedback of agreement and disagreement within the group to facilitate discussion or debate (Read and Gear, 1993). Keeney and Raiffa (1972) argue that a good analysis should illuminate controversy - to find out where basic differences exist, and to increase the level of debate. Dant (1991) states that "social knowledge, as it is shared by people, exists as discourse. Knowledge becomes and is available for sharing when it is uttered; either spoken or written down. Certain formalised types of knowledge may reside within people but they acquire or transfer their knowledge through discourse". Conflicting views may arise during group meetings. Some conflicts may be resolved through verbal debate (Liou and Nunamaker, 1993).

In this stage, the screen displays and feedback are used to help identify differences and disagreement, and thus help identify useful points of debate and discussion.

The display of inputs and differences is followed by focused debate and discussion. The participants are encouraged by the moderator to explain their inputs, give reasons or defend their personal judgement and intuition. They may also criticise other participants' inputs.

Because individual participants' inputs and judgement may be limited by their experience and background, the focused debate and discussion can help the participants share understanding, exchange information, knowledge and expertise (Read et al., 1998). In order to produce a balanced debate and discussion, the group moderator or facilitator should actively elicit opinions from the more quiet participants and actively quiet those who are too outspoken (Webler et al. 1991).

Step 5. Re-score and re-weight the factors after the screen feedback and debate

After the screen display feedback and the focused debate on differences and disagreement, the participants are asked to re-score and re-weight the factors concerned.

In this stage, the membership of the subgroups should be shuffled before re-entering inputs. The participants are asked to input their judgement by filling in the same data form or answering the same questionnaire as Step 2. A majority voting procedure may be applied within the subgroups to reach agreement among the subgroup members.

The intention is to reduce the differences in inputs between different subgroups, and thus to help achieve consensus.

Step 6. Repeat Steps 2, 3, 4 and 5.

Repeat Steps 2, 3, 4 and 5 until there is some form of consensus or agreement, and/or differences within the group are understood by the participants.

Step 7. Voting

Following Step 6, if disagreement still exists, a voting procedure on the disagreed scores and weightings should be conducted based upon the results obtained from Step 6.

Beveridge et al. (1997) argue that consensus requires a deliberate shift in emphasis away from individual opinions. Feedback to the group of individual judgements can help focused discussion and consensus building (Gear and Read, 1993). In reality, individual judgements are likely to be coloured by experience, professional category, as well as by the values of the group to which they belong (Johnson and Scholes, 1988). The group as a whole may fail to agree. However, commitment to consensus may be compatible with, and aided by, a voting procedure (Beveridge et al., 1997). The final results should conform to the rule of majority. The results from the above group process will be used as inputs to the next stage of marketing strategy development process – portfolio summary and setting strategies (See Table 2 and Figure 1 for details).

It is important to mention that one main problem with the process specified above is the loss of anonymity during debate and discussions. Some researchers (Aiken et al., 1994; Simmons, 1979) have noted that anonymity allows participants to exchange ideas or preferences without fear of ridicule due to "foolish" comments and also reduces the problems of "group think" and conformance pressure. By expressing anonymously, shy group members may participate more, and the group may state what they really think. Anonymity is also important for the delivery of criticism (Connolly et al., 1990). Eden and Ackermann (1998) argue that successful negotiation often depends on participants being able to "save face", as they change their mind and attitudes about possible outcomes and need to reconcile the stand they now take. "Saving face" can be made easier if opinions or comments made without attribution to a particular individual. With anonymity, people are likely to be more honest because the participants do not have to worry about the consequences (Janis, 1972; Moulin, 1988). Losing anonymity means losing the above-mentioned benefits.

While anonymity has been found to be useful at improving the effectiveness of group meetings, it is criticised for removing the opportunity for face-to-face communication (Watson et al., 1988; Finlay and Marples, 1992). Electronic communication is often seen as less "rich" than face-to-face verbal interaction (Daft et al., 1987). While media richness appears to be unimportant for information exchange (Rice, 1992), it may be critical for reducing the equivocal expressions that arise when there are multiple and conflicting interpretations of information (Daft and Lengel, 1986). The implication is that, while anonymity may be valuable for the generation of information, resolving differences among participants may be done best through verbal interaction (Dennis et

al., 1999). The integration of information and the resolution of different interpretations may be best done verbally (Daft and Lengel, 1986). Because the individual units each have "partial knowledge", i.e. that knowledge is dispersed within organisations (Bass, 1983; Minkes, 1987), face-to-face debate can be one form of communication to facilitate the exchange of knowledge between participants . Webler et al. (1991) argue that the benefits of anonymity do not eliminate the need to give up anonymity when there is disagreement among the responses. In the group support process proposed in this study, anonymity is surrendered during debate and discussions to enhance consensus building.

2.2 Fuzzification of strategic inputs using fuzzy logic

The SWOT analysis results from the specified group Delphi process (or from individual users if the group Delphi process is not used) are aggregated based upon the scores and weightings in terms of market attractiveness and business strengths. The aggregated group evaluation results are then fuzzified by a fuzzification component which is an integral part of the hybrid approach. Fuzzification of marketing strategy factors has been discussed by Li (2000a) and Levy and Yoon (1995). Within the hybrid approach of this study, fuzzy logic is employed to handle the imprecise measures and uncertainty in assessing the strategic criteria of the nine-cell portfolio model (Day, 1986) and the four-cell portfolio model (McDonald, 1996).

Conventional methods deal with the strategic criteria in a "crisp" or "clear-cut" way. For example, there is an abrupt change from "low" to "medium" or from "medium" to "high". The use of fuzzy logic is to enable a gradual change with certain confidence on strategic options when the values of the strategic criteria increase or decrease. In addition, confidence with a specific strategic option within the same cell may also vary, depending on the actual values and the membership functions defined.

In this hybrid approach, business strengths and market attractiveness are fuzzified through converting them into membership functions. To simplify the calculation of the inferential logic, trapezoidal membership functions (Levy and Yoon, 1995; Li, 2000a) are used. As an example, the fuzzified nine-cell portfolio models are illustrated in Figure 2. Other portfolio models can also be fuzzified in a similar way (Li and Davies, 2001).

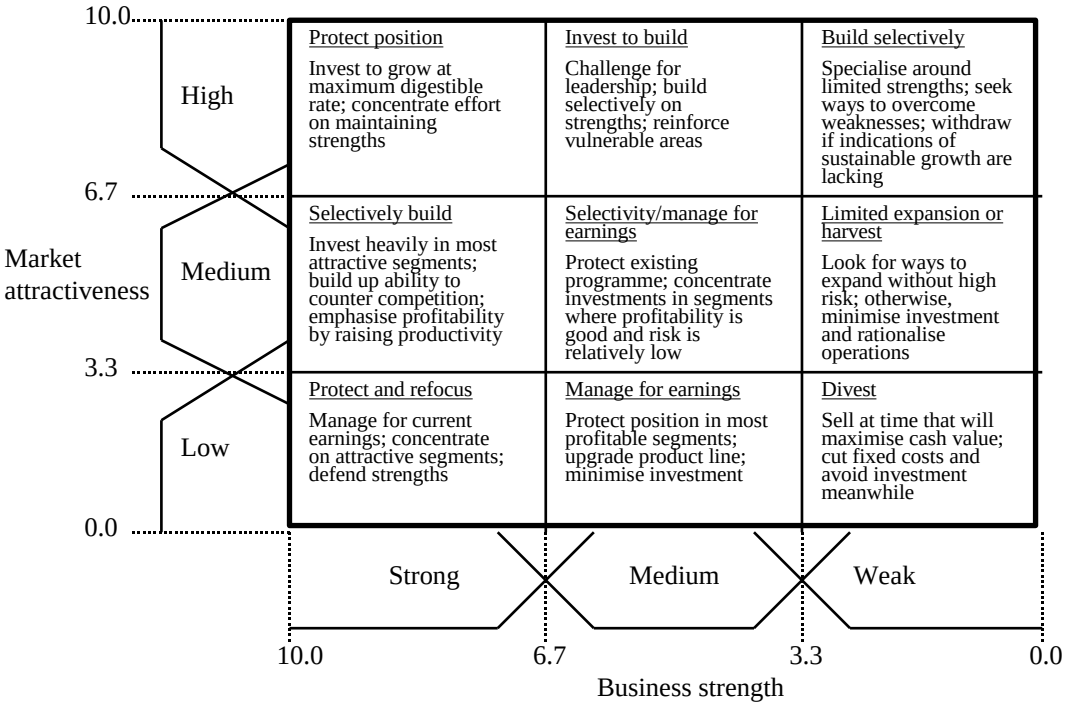

Figure 2. fuzzified nine-cell portfolio model with membership functions

2.3 Intelligent reasoning for setting strategies using expert system rules

Within this hybrid approach, expert system rules are designed to derive advice or recommendations based upon the fuzzified strategic inputs and the fuzzified portfolio models. The portfolio models implemented in the expert system rules include Day's nine-cell portfolio model (Day, 1986) and McDonald's four-cell directional policy matrix (1989a, 1996).

Some typical fuzzy rules for the fuzzified nine-cell portfolio model (shown in Figure 2) are listed below:

IF fuzzified business strength is strong
AND fuzzified market attractiveness is low
THEN fuzzy strategy is to protect and refocus with certain confidence

IF fuzzified business strength is strong
AND fuzzified market attractiveness is medium
THEN fuzzy strategy is to selectively build with certain confidence

IF fuzzifed business strength is strong
AND fuzzified market attractiveness is high
THEN fuzzy strategy is to protect position with certain confidence

All the rules whose conditions match or partially match will contribute to the final advice on strategic options. The final recommendation may be more than one strategic option with different degrees of confidence. In addition, further guidelines on the recommended strategy are also available in the form of hypertext.

The expert system module is an integral part of the hybrid approach. A detailed discussion on fuzzy reasoning for setting marketing strategies can be found in Li (2000a).

2.4 Guidelines on linking the hybrid approach with managerial judgement

Based on the hybrid approach proposed in the previous section of the paper, the following guidelines are proposed to help practitioners to link a manager's intuition and judgement appropriately with the hybrid approach.

1) The hybrid approach focuses on improving the effectiveness of the marketing strategy development process; helping managers in the decision-making process; and supporting, rather than replacing, managerial judgement and intuition (Keen and Scott Morton, 1978).

2) Experienced managers have good judgement and intuition (Mintzberg, 1994a, 1994b). They should always be an integral part of the strategy development process. Managers get support from the system without the need to understand or develop analysis models. Managers also retain reasonable control over the strategy development process.

3) Managers are flexible and creative. However, managerial judgement and intuition may be limited by experience, background and social environments (Minzberg, 1994b). Many managers lack strategic analysis skills. The support system can provide analysis aids and information processing support. The system is unbiased and consistent but rigid. Both the system's consistency and managerial flexibility should be incorporated. Harmonic interplay between the decision-makers and the hybrid system should be attained to produce a total effect for the strategy development process through utilising the powers of both parties.

4) The group Delphi process is intended to build sound group judgement and consensus. The fuzzification and the expert system rules are intended to aid and complement managerial and expertise. This means the support system's general knowledge is combined with the managers' specific knowledge about their products and markets.

5) To achieve the linkage or coupling of managerial intuition and judgement with computer-based support, the following three-step procedure should be followed:

a) The computer presents questions and asks managers to input relevant judgement and beliefs by scoring and weighting relevant strategic criteria or factors. Managers feed their judgement and intuition to the strategy development process through the user interface by using slides, scroll bars and edit boxes as discussed in Section 2.1. Managerial judgement and beliefs are entered in the form of scores and weights for the specific factors. Because the inputs from individual managers may be restricted to

their experience and backgrounds, group judgement and intuition should be sought. If a group of managers are involved in the decision-making process, the specified group Delphi process should be employed to aid the group meeting for SWOT analysis and obtain agreed group judgement as inputs to the stage of portfolio summary and setting strategies.

b) The computer receives inputs (judgement and intuition) from a group of managers (or a individual manager if the specified Delphi process is not used) in the form of scores and weights (relative importance). As discussed in Section 2.2, the system first converts the inputs into aggregated scores. It then fuzzifies the aggregated inputs according to pre-defined fuzzy membership functions. This is followed by a fuzzy reasoning process using fuzzy expert system rules as discussed in Section 2.3. Finally, the system produces reasoned advice and strategic options with different degrees of confidence. Managers can interact with the computer by modifying the fuzzy membership functions, changing inputs to the system, selecting the strategic analysis models, etc.

c) The managers then review the system's outputs, intelligent advice and various alternatives (with different confidence levels) and assess their overall viability. They should also judge which alternative is most sound and thus choose a particular strategy. Managers' inputs to the computer, the computer's outputs, and managerial judgement on the outputs should be combined together to guide final strategy decisions.

3. Evaluation of the hybrid approach

Evaluation is the process of assessing a system's or a model's overall value (O'Keefe et al., 1987). It is also defined as the process of examining a system's or a model's ability to solve real-world problems in a particular problem domain (Borenstein, 1998).

Keen and Scott Morton (1978) point out that computer-based decision support systems should focus on improving the effectiveness of decision-making. The validation question, thus, is: does the hybrid approach make the process of marketing strategy development more effective?

To answer the above question, a comparison between the hybrid approach and a single expert system will be made. *The expert system model* is an experimental prototype that was built using expert system rules only. It is an expert system that implements Porter's five forces model (Porter, 1980, 1985), four-cell portfolio model (McDonald, 1996) and nine-cell portfolio model (Day, 1986). The expert system model was designed for the purpose of the evaluation and for the purpose of enabling the comparison between the hybrid approach and an expert system. The expert system model can be considered a subset of the hybrid approach. *The hybrid approach* is the integration of the following components: a specified group Delphi process for SWOT analysis; fuzzification of market attractiveness and business strengths; and the use of expert system rules for Porter's five forces model (Porter, 1980, 1985), the four-cell portfolio model (McDonald, 1996) and the nine-cell portfolio models (Day, 1986). The expert system rules component of the hybrid approach represent the same strategic analysis models as those implemented in the expert system model.

3.1 Research method and the selection of subjects

Keen and Scott Morton (1978) argue that one could compare the results before and after the use of a system. Similarly, Sprague and Carlson (1982) point out that the evaluation of a decision support system can be made on a before/after basis and the measurements may be collected through using questionnaires. In this study, the validation was undertaken on the basis of the comparison of results before and after using the system. The MBA & MA marketing students of a British business school were used as subjects for the validation.

McIntyre (1982) argues that the ideal subjects for a research experiment designed to assess a system or a model would be those who are expected to be actual field users. Based on a comparison of the performance of actual executives to that of business students, Green et al. (1966) note that the behaviour in these exercises appears to be relatively unaffected by the participants' outside experience. Because MBA & MA marketing students are receiving formal business training and are the frequent potential users of strategic analysis models and computer-based decision support systems, they have the interest and ability to act as surrogates for actual marketing managers. In this study, they were selected as subjects for the evaluation of the hybrid approach.

3.2 Evaluation questionnaires

Decision support implies the use of computers to: assist managers in their decision processes in semi-structured tasks; support, rather than replace, managerial judgements (Keen and Scott Morton, 1978). The use of computers should focuses on improving the effectiveness of decision-making (Keen and Scott Morton, 1978). Thus, the use of computer-based support systems should make the strategy development process more effective. In this study, the effectiveness is measured in terms of performance of decision activity (Keen and Scott Morton, 1978), decision confidence (Turban, 1995; Oz et al., 1993; Davey and Olson, 1998; Van Bruggen et al., 1996), level of consensus (DeSanctis and Gallupe, 1985; Turban, 1995; Sharda et al., 1988), quality of outputs of a system (Evans and Riha, 1989), quality of decisions (Keen and Scott Morton, 1978; Coll et al., 1991), etc. With regard to the provision of computerised support, the measurements for the effectiveness should also include helping strategic thinking (Porter, 1987; Mintzberg, 1994a, 1994b) and coupling strategic analysis with managerial judgement (Mintzberg, 1994a, 1994b, 1994c), etc. In this research, evaluation questionnaires were designed to measure the effectiveness as defined above. The measurements for the effectiveness were collected from the involved MBA & MA students through using the questionnaires in the evaluation workshops.

3.3 The evaluation workshops and research findings

MBA & MA marketing students participating in the Customers & Markets and Marketing Management modules at a British Business School were used as subjects. The first named author acted as an external researcher to run two evaluation workshops.

Two workshops were undertaken at the Business School's learning centre . Nine full-time MBA & MA marketing students attended an evaluation workshop in November, 2000. Five part-time MBA & MA marketing students participated in a workshop in December, 2000. Each of the workshops took about two and a half hours. The two workshops followed the same procedure as stated below.

Before the evaluation workshops, the MBA & MA students were provided with case materials (http://www.thecoca-colacompany.com/) about the Coca-Cola Company and its products. They were required to spend about two hours in studying the case materials, searching relevant information, and reviewing Porter's five forces model (Porter, 1980, 1985) and the portfolio models (Day, 1986; McDonald, 1996) for developing marketing strategies.

The process of validating the expert system model includes two stages. Firstly, the participants used the system to develop marketing strategies for the coca-cola product – Diet Coke in the UK soft drink market. The participants then used their individual inputs to run the expert system. Finally, they answered a questionnaire to assess the effectiveness of the expert system model.

The evaluation process for the integration of fuzzification and the expert system rules was arranged as follows. Firstly, the participants were asked to use the fuzzification and the expert system rules to develop marketing strategies for the Coca-Cola product – Diet Coke in the UK soft drink market. The participants then used their individual inputs to the system. Finally, they were asked to answer a questionnaire to comment on the effectiveness of the combined use of the fuzzification and the expert system rules.

The evaluation of the hybridisation of group Delphi, fuzzification and expert system rules was undertaken as follows. The researcher first introduced and explained the specified group Delphi process as discussed in Section 2.1. The participants then used the specified group Delphi process to assess the strengths and weaknesses of the Coca-Cola business, and the opportunities and threats of the UK soft drink market. They then used agreed group inputs to run the hybrid system. Finally, they were asked to answer relevant questions about the effectiveness of the hybrid of the group Delphi process, fuzzification and the expert system rules.

The responses from the two workshops are summarised in Table 2. It can be seen from the Table that the combined use of the fuzzification and expert system rules is more effective than the use of a single expert system on every one of the measures used. The hybridisation of the group Delphi process, fuzzy logic and expert system rules is more effective still, again on every measure. The hybrid approach delivered more effective support in terms of the following measures:

- Confidence about the output produced by the system or model
- Helping building group consensus
- Improving the performance of the decision activity
- Helping understand the factors that affect marketing strategy development
- Helping the coupling of strategic analysis with managerial judgement
- Helping strategic thinking
- Quality of the advice generated

- Helping improve the quality of marketing strategy decisions

One limitation of the evaluation workshops is the small number of participants and the short period of the evaluation process. Thus, evaluating the hybrid approach with larger number of participants in a longer period will be an important element in future research.

Table 2: Findings of the evaluation workshops

Measurement	**Use of a single expert system** (averaged score)	**Hybrid of fuzzification and expert system rules** (averaged score)	**Hybrid of group Delphi, fuzzification and expert system rules** (averaged score)
Confidence about the output or results produced (not confident 1 2 3 4 5 very confident)	2.18	3.48	4.05
Helping build group consensus (no help at all 1 2 3 4 5 extremely helpful)	1.63	2.91	4.04
Improvement on the performance of the decision activity (no improvement 1 2 3 4 5 significant improvement)	2.32	3.32	4.21
Helping understand the factors that affect marketing strategy development (no help at all 1 2 3 4 5 extremely helpful)	2.53	3.38	4.04
Helping the coupling of strategic analysis with managerial judgement (no help at all 1 2 3 4 5 extremely helpful)	2.32	3.58	4.19
Helping strategic thinking (no help at all 1 2 3 4 5 extremely helpful)	2.52	3.63	4.04
Quality of advice generated (low 1 2 3 4 5 very high)	2.31	3.32	3.80*
Helping improve the quality of marketing strategy decisions (no help at all 1 2 3 4 5 extremely helpful)	2.53	3.36	4.00*

Note: The sample size is fourteen full-time and part-time MBA & MA marketing students.
* This item was only evaluated by the five part-time MBA & MA marketing students and the result is based on their responses.

4. Conclusions

In this paper, a hybrid approach for integrating a group Delphi process, fuzzy logic and expert system rules for developing marketing strategies has been proposed. Guidelines on how to link the hybrid approach with managerial judgement have also been provided. The effectiveness of the hybrid approach has been validated with MBA & MA marketing students. Findings from the validation workshops suggest that the hybrid approach is more effective in terms of the following aspects:

- Confidence about the output generated by the system
- User performance of the decision activity
- Group consensus
- Helping strategic thinking
- Helping understand strategic factors
- Coupling strategic analysis with human judgement
- Quality of the advice generated by the system
- Quality of marketing strategy decisions

Marketing strategy development is a complex decision-making task where subjective judgement and intuition alone are normally inadequate. On the other hand, the computer-based support systems themselves are also not adequate because the process

involves managerial judgement. The key idea, therefore, is computer-based support plus human judgement and intuition (Keen and Scott Morton, 1978) so that joint effects can be assured.

Although the solution from computer-based support systems will never be complete, it is evident that the hybrid approach can help improve the effectiveness of the strategy development process. Intelligent hybrid systems, as a new form of computer-based support systems will receive more and more attention from both researchers and practitioners. Further work is being undertaken by the first named author to incorporate the group decision support software, the knowledge management technique and multi-agent technology to enhance the effectiveness of the hybrid approach. Evaluating the hybrid approach using different subjects with larger number of participants in a longer period will also be undertaken in the next stage of this study.

Acknowledgements

This paper and the work reported in the paper were completed independently by the first named author. Other authors offered support or comments.

The author would like to thank Professor Paul Finlay (Loughborough University, UK) for his constructive comments on this research. The author would also like to thank Professor David Hamblin (University of Luton, UK) for his comments on this study. The author also wishes to thank Ms Philippa Ward, Senior Lecturer in Marketing & Strategy, and Ms Beverley Hill, Senior Lecturer in Marketing & Strategy, for their support for the validation workshops.

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