CONSTRUCTING A KNOWLEDGE-BASED SYSTEM TO AID SCENARIO-BASED STRATEGIC PLANNING: AN APPLICATION TO THE EUROPEAN AIRLINE INDUSTRY

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SUMMARY

This paper explores the use of scenario planning and the design of a knowledge-based system in strategic decision making, in the context of the European airline industry. Several innovative strategies were derived, as well as other key recommendations based on sound strategic reasoning, and participants testified to the effectiveness of the approach in stretching their thinking. The requirement to draft strategies as expert system rules, with reasons, was useful in clarifying thinking and achieving group consensus. This methodology, therefore, aids effectiveness of the scenario planning process itself, while providing a dynamic, accessible means of storing the resulting strategic thinking. Copyright © 2005 John Wiley & Sons, Ltd.

1. INTRODUCTION

Today's rapidly changing market and technological environment presents many challenges for managers, and may necessitate radical changes in the way that management strategy is formulated. Yet, in situations of uncertainty, the tendency is to return to the familiar, to draw on past experience and tried and tested methodologies. Managers, therefore, need to be trained in techniques which will give them the confidence and ability to go beyond what they know, in order to develop more effective and innovative strategies. One such technique is scenario planning, an approach to developing strategy which encourages managers to break from the confines of traditional perspectives, and which is employed to good effect by major companies such as 3M and Hewlett Packard (Legare, 1988). This study examines the use of scenario planning in management education: specifically, at an international managerial summer school for practising managers from major companies. Both the process of strategy formulation and the output are considered, in order to assess not only whether far-sighted, innovative and effective strategies are produced, but also what benefits are gained from the group process itself. Furthermore, the strategies emerging from the exercise were recorded in the form of rules in a knowledge-based system (KBS), and the paper also considers whether there is added value in capturing information in this way.

The literature review which follows gives a rationale for the use of scenario planning, discussing the process, its benefits and use, before moving on to consider KBSs and how they could aid scenario planning. The paper then continues with a brief background to the scenario planning exercise, followed by detailed discussion of the exercise itself.

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2.   LITERATURE REVIEW

2.1.   Changing Markets and Environmental Uncertainty

As Baden-Fuller *et al.* (2000) point out, rapidly changing markets and technologies may necessitate changes in strategic management thinking, and an effective response may mean being unafraid to challenge traditional methodologies and paradigms. However, Wilson (1999) points out that managers facing volatile situations tend naturally to draw on their own experience and intuition, to draw parallels with situations they have faced before, and to use decision rules based upon these. He identifies a need for strategic planning techniques which challenge traditional company perspectives and priorities, rather than reinforcing them, and calls for organizations to be constantly challenged to focus on strategy and competitiveness—otherwise the tendency is that new strategic planning initiatives will only be considered when the company is facing threats to its profitability or even survival. Whitehill (1997) points out the ease with which new companies can now analyse products and services available in the marketplace, and acquire the appropriate tangible assets and resources to enter the market and match or better existing offerings. Yet a focus on established products, practices and perspectives may well blind companies currently in the market to such emerging opportunities—until competitors have exploited them. Wilson (1999) cites examples such as IBM, whose 1986 strategic review did not question the company's reliance on computer mainframe products despite the emerging PC market, and Marks and Spencer, whose 1985 review of IT requirements made minimal recommendations for change in order not to disturb the established culture of the firm.

So the first requirement for managers to be able to respond effectively to environmental and market developments is that they should recognize such developments as important. They then need to develop adequate techniques, frameworks and methodologies to deal with these developments, their possible impact, and suitable responses (Wilson, 1999). Ashill and Jobber (2001) found that managers recognized three components to this problem:

- they might lack information on environmental factors, so could not predict what was going to happen;
- even when they could predict likely changes, they might not be able to predict the impact of such changes on their company or decision making;
- even when they could predict the impact, they might still not know how best to respond effectively.

These components correspond closely to the three types of uncertainty identified by Milliken (1987, 1990): state uncertainty (the environment is unpredictable), effect uncertainty (the impact is unpredictable), and response uncertainty (range, utility, and/or consequences of responses cannot be predicted). Miller (1993) points out that different types of environmental uncertainty (e.g. political, macroeconomic, competitive, technological) may have vastly different strategic implications for a company.

2.2.   Scenario Planning

Furrer and Thomas (2000) have devised a framework, the 'rivalry matrix', which categorizes strategic modelling approaches according to their suitability in particular types of environment and the

number of decision variables involved. In uncertain environments, they recommend that, with a large number of decision variables, rigorous modelling is impossible due to the level of complexity, and decision frameworks such as Porter's five forces (Porter, 1980) or Thomas's (1984) framework are required. However, if a small number of critical decision variables can be isolated, one recommendation is the use of scenario planning (others being simulation modelling and system dynamic modelling). This is an approach that recognizes today's rapidly changing market and environmental conditions, and the difficulties these pose for strategic planning. Instead of trying to make accurate predictions and formulate one optimal strategy, scenario planning encourages the construction of several possible 'alternate futures' (Simpson, 1992) and the planning of strategy in response to each. The technique is employed by many major companies, such as 3M, British Airways, Hewlett Packard, ICI, and Levi Strauss (Anon, 1988; Legare, 1988). Key decision makers within the company offer opinions on the most important environmental trends, greatest uncertainties, and decisions which will impact most greatly upon the company, in order to aid the construction of credible, consistent and challenging scenarios (Simpson, 1992; Bloom and Menefee, 1994; Tucker, 1999). Once scenarios have been formulated, the company organizes a workshop or brainstorming session, ideally with a diverse group of participants (Tucker, 1999). Such participation will utilize more fully the knowledge within the company, and should be encouraged, as broader participation in decision making has been shown to correlate with higher company performance (Papadakis, 1998). Alternatively, a diverse group may be involved from the beginning, in identifying the environmental and industry drivers which will impact the future, and constructing alternative scenarios (Mercer, 1995). In responding to scenarios, there are two possible starting points (Thomas, 1994):

- from the company's current strategy, to examine how it would hold up in the situation envisaged in each scenario;
- from the future envisaged in the scenario, to examine the necessary strategies for survival and profitability in that situation.

The scenario planning approach differs from others in using 'storylines' to describe different futures (Schoemaker, 1993); Wright (2000) sees this as being easier to 'connect with' than the diagrams and figures that form the basis of more traditional planning methodologies. It also enables incorporation of more subjective elements and macro-environmental variables that could not easily be included in computer simulations, due to the difficulty of expressing them quantitatively or defining them within the boundaries of the simulation (Schoemaker, 1997). It is wider in scope than contingency planning, which looks at only one uncertainty at a time, and sensitivity analysis, which considers change in one variable only, and cannot cope with major environmental changes which affect several variables (Schoemaker, 1997).

Phelps *et al.* (2001) found some evidence that the use of scenario planning improved decision-making, and could also impact company performance. However, advocates of the technique stress that its greatest value lies in the long-term changes to participants' viewpoints which are engendered by the creative thinking required (Schoemaker, 1995; Mercer, 1995). As managers broaden their outlook to different ideas of what the future may hold, they become less certain about the rightness of their decision making. The process of considering alternative futures, and brainstorming with others who have different perspectives, broadens participants' thinking, combats marketing myopia and opens their minds to new possibilities—as long as they are willing and motivated to engage fully in the process. Verity (2003), in examining why scenario planning has not been more widely adopted, states that managers have difficulty in accepting the idea of an unpredictable future about

which they cannot make confident and clear judgments. She draws on evolutionary psychology theory (Cosmides and Tooby, 1997, quoted in Verity (2003)) to show that this is a natural tendency—we do not like uncertainty, and tend to downplay risks and make assumptions from what we know. Furthermore, we tend to admire leaders who are confident and bold in their convictions, and the broader and more flexible outlook developed through scenario planning does not fit easily with this leadership style.

Bood and Postma (1997) divide the functions of scenarios into two clusters: more traditional ones which provided the impetus for the development of the methodology (evaluating and choosing strategies, synthesizing different types of data about the future, exploring the future and identifying opportunities), and those which have only come to be realized as the methodology has been used (generating or increasing awareness of environmental uncertainties, challenging managerial thought patterns, stimulating organizational learning). They point out the usefulness of challenging scenarios in dissolving four 'bottlenecks' to organizational learning: cognitive inertia (the tendency to think in accordance with existing rules, norms and assumptions), the time lapse between practical strategy implementation and effect of the strategy being seen, 'groupthink', and inability to reach agreement due to conflicting thinking between managers. Which of the last two is most likely in any situation will depend on how convergent is the thinking of the various decision makers involved, and the authors stress the necessity of achieving a balance in this respect, when choosing participants. In particular, the use of outsiders as well as internal managers should help to guard against groupthink and tendencies to conform to organizational norms, which may override an individual's natural inclinations (Verity, 2003).

An environment of increasing turbulence enhances the need for companies to have a vision for their future (Oosthuizen, 2000). O'Brien and Meadows (2000, 2003) found that typically such a vision was imposed by communication from the top, rather than being developed participatively. A robust vision cannot be independent of the future environment, and thus scenario planning would seem to have a place in visioning, although few companies use it as yet (O'Brien and Meadows, 2000). O'Brien and Meadows (2001) tested a scenario-based methodology (CHOICES) for visioning in the public domain, and found that the development of future scenarios helped participants to have a broader view of the future and to develop stronger and clearer vision statements.

Various authors have suggested how scenario planning can be integrated into an organization's planning procedures. Schoemaker (1997) proposes its combination with competitor analysis, to identify the requirements for success in particular market segments in each future scenario. Verity (2003) describes models developed by different management consultancies, using expert judgment, cross-impact analysis and trend-impact analysis, to provide simulations of the future—she suggests that the very flexibility of the scenario planning process limits its acceptability to managers, resulting in this type of incorporation into a more formal approach. Courtney (2003) distinguishes between vision-driven and decision-driven scenario planning, the latter being an adaptation of the process to more short-term strategic decision making, when there is some level of uncertainty that makes it worth developing alternative scenarios (e.g. new product launch when consumer demand and competitor reaction are uncertain). Strauss and Radnor (2004) seek to satisfy both strategic and operational demands by blending scenario planning with 'roadmapping'; having identified a future scenario, the organization moves to the micro level to describe in detail what customers would require in that situation, and what technological development that would entail. The authors recognize the difficulties, not to mention time and resources, inherent in combining such different levels and perspectives, but believe that benefits will accrue in turbulent conditions when the wrong decision could have drastic consequences.

Millett (2003) emphasizes the necessity of adapting the scenario approach to the culture of the company and its particular problems, and recommends the use of automation to reduce time and costs. Gnyawali and Grant (1996) also stress the value of a high-quality information system which interacts with the scenario planning process, in optimizing its contribution to organizational learning. Automation allows outline scenarios, the information and assumptions on which they are based, and the strategic decision-making process to be recorded for the future. Scenarios can then be revisited when new environmental developments occur. Artificial intelligence, in the form of a KBS, could be an appropriate medium for such automation. Thus, the next section of this paper examines the use of KBSs in marketing strategy formulation, assessing their potential for use in scenario planning.

2.3. KBSs in Marketing and Scenario Planning

A KBS, or expert system (ES), consists of software which can store and interpret knowledge, thus providing 'expert' advice to users and acting as an aid to decision-making. The basic ES model is a rule-based system, which tests a new problem situation against a database of rules formulated by experts. Curry (1992) listed the benefits of such models as the transparency of the rules, which are written in a form similar to natural language, the facility for qualitative reasoning, user friendliness, and the provision of explanations for the advice given. Cavusgil and Evirgen (1997) stressed the importance of management being able to 'play out' different 'what if?' scenarios. The role of an ES was perceived as an aid for decision makers, rather than as a replacement for them; Curry (1996) suggested that ESs help management to evaluate their thinking, and to reflect upon their decision-making criteria and processes, while Stone and Good (1995) found that the use of an ES fostered an environment that enriched the management structure and improved the speed of decision making. Many marketers were keen to investigate the benefits of ES technology; Singh-Chand et al. (1995) noted its increasing use by marketing managers in formulating strategic marketing decisions, including the recommendation of strategic options, while in Stone and Good's (1995) survey of 117 US marketing executives, all reported the successful use of an ES in their organizations.

ES development and use, however, can bring its own problems. Cavusgil and Evirgen (1997) suggested international marketing as a suitable domain for ESs, due to the scarcity of expert knowledge and the complexity and uncertainty of the international marketing environment. These factors support the potential usefulness of an ES, but also point to what many authors have identified as the main difficulty in ES development, that of knowledge acquisition, which involves both identifying appropriate expertise and then enabling it to be expressed in a rule-based format. Dubelaar et al. (1991) pointed out that both factual and procedural knowledge needs to be encoded, and that, as knowledge is always evolving and being added to, there needs to be a facility for updating the system. Li et al. (2000) found dissatisfaction among managers with current computer-based systems designed to aid marketing strategy decision making, the most common complaints being limitations on their support capabilities, function and scope, and an inability to couple strategic analysis with managerial judgment, deal with uncertainty, or meet managers' real needs.

The search for improvement led to the development of ES through model-based systems in which a model is built to make predictions about the problem situation, to the most recent form, case-based systems (CBSs) which find solutions through accessing and analysing previous cases similar to the current one (Bonissone, 1993; Mansfield, 1997: 13, Frangou et al., 1999: 146). Dramatic increase in ES use within manufacturing organizations led to more rigorous assessment of their value, and recommendations (Guimaraes et al., 1995; Yoon et al., 1995) to increase the likelihood of project success and user satisfaction, including:

- adding problem difficulty as a criterion for ES applications selection;
- shaping end-user attitudes and expectations regarding ESs;
- increasing ES developer training to improve people skills.

Others seeking to overcome the limitations identified by Li *et al.* (2000) in the use of ESs in the domain of marketing strategy have sought to integrate ESs with other support technologies such as decision-support systems (Duan and Burrell, 1995). Li and co-workers (Li, 2000; Li and Davies, 2001; Li *et al.*, 2002) went further. They developed hybrid systems which used group Delphi to ensure that multiple opinions were represented at the knowledge elicitation stage, a forecasting module based on an artificial neural network, fuzzy logic to deal with ambiguity and uncertainty, integrated with an ES to hold domain knowledge and provide reasoning capabilities. Evaluation of these suggested that the integration of these different techniques improved managerial confidence in the system output and encouraged strategic thinking.

The focus of this paper, therefore, revolves around the reinforcement of the relevance of scenario planning when combined with the end-use of a KBS as antecedent managerial tools for strategic decision making. Apart from the objective associated with this methodology of increasing the effectiveness of management decisions, this approach is also designed to stimulate strategic thinking processes and the design of innovative strategies. The emphasis put on the value of capturing information should be paramount; this issue is critical when modelling uncertainty and, more specifically, uncertainty reasoning. The methodology related to the elicitation of the information and the capitalization on the background knowledge of the participants, as well as the sociometric mechanisms associated with consensus decision making, are all designed to challenge current mind sets. The combination of scenario planning and the utilization of an ES is also linked with the awareness and implementation of contingency planning. The synthesizing of the pertinent information into scenario factors, combinations, options and the stimulation of strategic reasoning capabilities are all good instruments to minimize corporate 'bottlenecks' and corporate inertia. Figure 1 depicts the influence that a methodology linking scenario planning with the design of a KBS has on strategic decision-making.

In the study now described, in-depth discussion of future scenarios, with a facilitator present, meets the need for multiple inputs to the knowledge base. As the input is text based, it can handle the subjective and descriptive elements of scenarios, while also having the facility to deal with quantitative input. Furthermore, the system should be able to deal with uncertainty as to the future environment, because its rule base, based on scenario development, will contain details of several 'alternative futures'. It also has the potential to be added to as required through the development of new rules. The domain of the system is one in which the changing environment has created a great deal of uncertainty, and this is now discussed.

2.4. The European Airline Industry

The European airline industry is one which has undergone radical change in recent years, due to deregulation (1987–1997), the removal of subsidies to national airlines, increased demand for both business and consumer travel, and the emergence in the UK and Ireland of low-cost, no-frills airlines, operating from smaller regional airports, reducing distribution costs by using direct Internet booking, and minimizing maintenance costs by restricting their fleet to one type of aircraft (Mintel, 2001). Successful low-cost airlines have taken significant market share from traditional carriers (Flottau and Taverna, 2001), and several major airlines have attempted to introduce their own low-cost
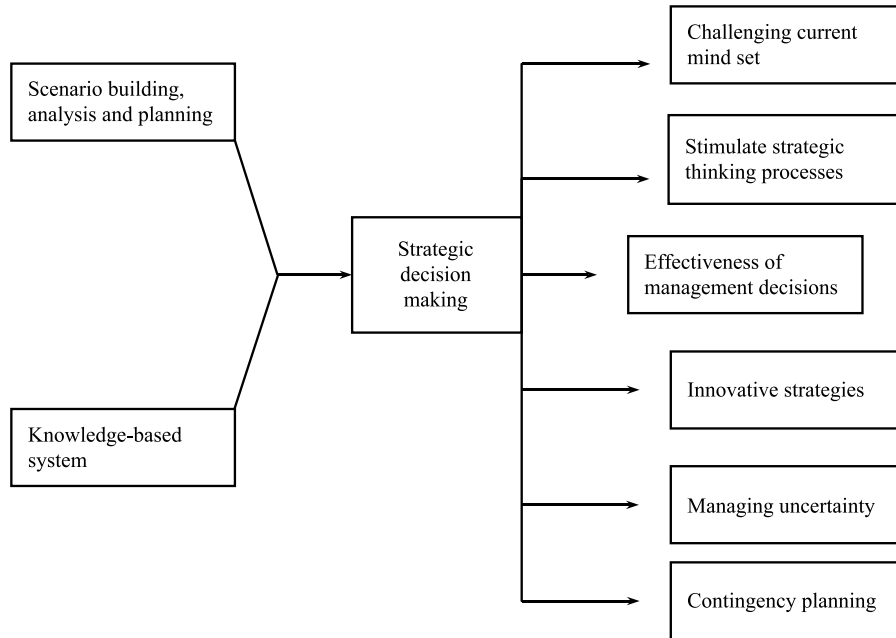
Figure 1. Influence of the link between scenario planning and the development of a KBS on strategic decision making

subsidiaries, with varying degrees of success. Another response to changing market conditions has been to form alliances, four of which now account for over 90% of international global passenger traffic (Mintel, 2001). These have many benefits (Gudmundsson, 1999), but they can prove unstable. Cross-shareholdings are common, with many European regional airlines consolidating relationships with larger carriers to stay in profit (Flottau, 2000). Downsizing and outsourcing measures can also be observed, with airlines such as Air France, the SAir group, KLM and Lufthansa trimming networks to focus on profitable routes and core operations (Sparaco, 1999a; Anon, 2001; Morrocco, 2001).

The market environment is still in a state of constant change. A growing market for air travel provides opportunities for expansion, while increasing competition, capacity problems, airport congestion, declining revenue per seat, and increasing fuel costs are threats to profitability (Gudmundsson, 1999; Sparaco, 1999b; Flottau, 2000; Moorman, 2001). Economic recession in certain regions, the dollar exchange rate, increased environmental awareness, environmental regulations, developments in other transport links, and transfer of airports from public to private control may affect the industry in ways that cannot be easily predicted (Flottau, 2000; Mintel, 2001). These characteristics, coupled with the fact that the industry is one with which most managers would have some degree of familiarity, from use and/or press coverage, led to the choice of the European airline industry as a suitable setting for a scenario planning exercise.

2.5. Downsizing and Outsourcing

The practice of downsizing, initially a reaction to economic recession in the late 1980s–early 1990s, has left a lasting impact on business culture. Concerns about profitability continue to lead companies to shed staff, citing reasons such as business process re-engineering, increased automation, and

improved staff utilization; and the increasing availability and affordability of technology aids greatly in this pursuit of leanness. Companies 'staffing for profitability' may have only a small core of permanent staff, using 'contingent' employees to vary the size of the workforce as demand necessitates (Van Horn-Christopher, 1996), or they may outsource one or more business functions to outside firms. Outsourcing may be driven by vision and function as well as economics (Harkins, 1996); though cost control is the most commonly cited reason for outsourcing, others include a focus on core competencies, improving access to and utilization of new technologies (Kakabadse and Kakabadse, 2002), lack of expertise, difficulty of keeping technology up to date, and the wish to improve flexibility or supply chain capabilities (Wong *et al.*, 2000). The most commonly outsourced functions are legal work, shipping, production and manufacturing, logistics, and information systems (Lankford and Parsa, 1999; Wong *et al.*, 2000).

Turning to the industry considered for this study, it is widely recognized that airline companies must be part of the global network if they are to remain competitive. Rationalization might be viewed as a logical response to the increasingly uncertain environment confronting airline firms, and there may be technologies or business functions available from outsourcers that may complement the company's strategic strengths and core competencies. The decision to outsource can, therefore, lead to competitive advantages, so effective management of the outsourcing relationships is an organizational imperative.

Both downsizing and outsourcing, however, have long-term dangers: they may lead to increased worker insecurity, lower morale, and a decline in motivation and loyalty (Cooper, 1998), a culture of risk avoidance (Love, 1998), and loss of corporate knowledge (Whitehill, 1997), with negative long-term effects on competitiveness and profitability (Haapaniemi, 1996). Neither does outsourcing necessarily bring the hoped-for economies of scale and cost reductions (Lankford and Parsa, 1999), while external control of vital resources such as the information systems function may cause problems (Wong *et al.*, 2000). Thus, it is generally recommended that only non-core activities which add neither competitive advantage nor value should be outsourced, though Baden-Fuller *et al.* (2000) challenge this traditional strategic thinking and suggest that, in certain circumstances, some core activities could advantageously be outsourced.

As disadvantages of downsizing become evident, companies are realizing the need for a more strategic approach, balancing needs for cost reduction and efficiency with willingness to invest in and develop key resources. Particularly in uncertain economic or market environments, organizations need to explore innovative ways of achieving such balance; but managers encouraged in a 'lean and mean' approach may have difficulty in thinking 'outside the box' to propose solutions. Scenario planning is proposed as one method by which more innovative strategic thinking may be stimulated, and the paper now describes the methodology of its application to the airline industry. The analysis concentrates particularly on scenarios where downsizing or outsourcing is, or could be, recommended, in order to judge whether scenario planning has enabled participants to think more creatively and innovatively.

3.   METHODOLOGY

The ES was constructed from decision rules that were elicited using a set of scenarios based on the European airline industry. These data were obtained during teaching sessions conducted between 1998 and 2001 at the European Summer School for Advanced Management (ESSAM). Participants were all delegates, and many were also practising managers in major companies.

The scenarios constructed dealt with a number of critical environmental and competitive dimensions that had been identified by the course leaders and modified through discussion of these factors in teaching sessions on environmental scanning. A list of 37 factors was identified in 1998 and increased to 40 in future years following suggestions from participants. Each factor was defined and given a description. Four example factors are shown below.

- *Fixed costs*: total costs that do not change with volume, but might change on a per-unit basis.
- *Variable costs*: total costs which change with volume, but are fixed on a per-unit basis.
- *Quality of suppliers*: attributes of suppliers, including such aspects as speed, reliability and consistency.
- *Partnership agreements with suppliers*: the set of relationships that improve the value chain and go beyond a contractual arrangement.

The groups were introduced to all the factors and these were explained so that everyone was familiar with the definitions and agreed with them.

In the scenarios, these factors were allowed to assume three different values. They could increase, remain the same or decrease. This rather restrictive set of conditions was necessary in order to simplify the programming of the ES and allow it to be constructed and validated within the time limits imposed by the course. The four factors above were allowed to vary as follows:

Fixed costs
In the future, are fixed costs likely to . . .   increase, stay the same, decrease

Variable costs
In the future, are variable costs likely to . . .   increase, stay the same, decrease

Quality of suppliers
In future, is the importance of the quality   increase, stay the same, decrease
  of suppliers likely to . . .

Partnership agreements
In the future, is the importance of partnership   increase, stay the same, decrease
  agreements with suppliers likely to . . .

The scenarios identified a set of conditions, and it was the task of the participants to decide on a course of action given these conditions and provide reasons for the action taken. Each scenario was designed using a subset of only five factors. This requirement was imposed to provide some control over the specificity of the ES. If a scenario contained only one rule, e.g. a rule about what action to take if fixed costs increase, then this action would be identified in all cases where fixed costs increase. On the other hand, if a scenario was based on many rules, e.g. a specific response for each of the 40 factors, then the resulting action would only be identified for this very specific case. Too few rules in the scenario and the recommendations tend to be numerous and too general, whereas many rules tend to make the recommendations specific and rare.

It was not the intention to construct an exhaustive ES which dealt with all possible combinations of factors. Clearly, this would have led to an extremely large knowledge base, much of which would have to be based around unlikely or even impossible scenarios. Scenarios were based around

optimistic and pessimistic predictions about the future and also no change, unusual and specific incident scenarios (for example, what would happen if the Euro plunged in value compared with the dollar?). Some scenarios were provided by the course leaders, while others were modified or constructed entirely by the participants. An example of a scenario is provided below.

The following scenario predicts how five factors will change in the future.

- the *importance of IT* is likely to *increase*;
- the importance of *risk spreading* is likely to *increase*;
- *resources available* are likely to *decrease*;
- the importance of *communication mechanisms* is likely to *decrease*;
- the importance of *maximizing the value chain* is likely to *increase*.

Participants were asked to provide recommendations based on these conditions and also provide reasons for them. For example, the recommendation made for the above scenario might be to:

- use an IT-based outsourcing strategy
- invest in technology and automation

with the reasons for this action being

- emphasis in the future is likely to be on technology and the need to spread risk whilst maximizing the value chain.

The participants were divided into groups and provided with the following instructions about how to complete the scenarios.

Guidance for Completing Rules
The scenarios provided give the conditions that apply for a particular company. You are required to decide on a course of action and provide a reason for this action. In order to provide some context for your recommendations, the company we are to consider is . . .

> a European airline with more than 500 employees, catering for the mass-market (for example, easyJet or RyanAir). We will be concerned with recommendations made in response to predictions about how the factors are likely to change in the future (about 2–4 years).

Recommendations and rules need to be agreed amongst the entire group. As all recommendations and reasons will be added to the ES by the elective organizers (in a limited amount of time), please provide brief notations.

Avoid the obvious and circular reasoning, such as:

Scenario:
- the *Asian market* share is likely to *increase*
- the importance of *mergers and acquisitions* is likely to *increase*
- the importance of *strategic alliances* is likely to *increase*
- the importance of *defranchising* is likely to *increase*
- the importance of *share of voice* is likely to *increase*.

Table I. Progressive development of rule base

	1998	1999	2000
Pre-formulated scenarios	10	10	10
Participant-designed scenarios	30	23	16
Total scenarios (no. of rules)	40	73	99

Recommendation:
- make more strategic alliances, increase advertising budget.

Reason:
- the importance of strategic alliances and share of voice is likely to increase.

Once rules and reasons had been agreed in the group, the rule was added to the rule base. Table I shows the progressive development of the rule base over 3 years. The workshop thus fulfilled to some extent the recommendation of managerial involvement in scenario design. It was hoped that the diversity of backgrounds and nationalities would guard against any danger of groupthink; but, in case it did not, or conflicting ideas threatened the group's progress, one of the authors acted as a group facilitator, challenging or peacemaking as deemed necessary.

This paper now goes on to analyse the ES rule base, examining the thinking of these international managers on scenarios where downsizing/outsourcing is appropriate, and on alternatives to downsizing/outsourcing, while also critically appraising the outputs provided by the group in order to assess the benefits of the exercise.

4. ANALYSIS OF THE RULE BASE

The analysis of the final, 99-rule ES is now considered, examining the rules recommending downsizing or outsourcing in order to reveal the market conditions in which these measures are thought to be appropriate. A comparison of these with conditions which have traditionally led to downsizing, coupled with an appraisal of other solutions suggested under such conditions, will indicate how successful the scenario planning methodology has been in encouraging more innovative managerial thinking.

Table II details the factors most commonly used in scenario building, with an indication of how they were set to vary. These cover the major areas discussed in the foregoing analysis of the European airline industry, and in most cases all three possible variations have been used, thus indicating that a wide range of alternative futures have been considered. Of the 99 rules, 45 recommended downsizing or outsourcing, either generally or more specifically, and Table III shows the major factors causing such recommendations.

Downsizing/outsourcing can be seen here as a response to a more uncertain and competitive environment, as a measure to improve the cost structure, and hence profitability of the firm, or as a way of coping with a shortage of skilled staff or required resources. These are in line with much general corporate practice. General downsizing may be a result of business process re-engineering and/or integration. Outsourcing of IT functions was the most frequent single recommendation when IT and innovation were seen as increasing in importance but the firm did not have in-house resources

Table II. Factors most often used in scenario building

Factor	How often used	Decreasing	Staying the same	Increasing
Importance of salaries	26	2	11	13
Market turbulence	25	7	7	11
Staff quality	22	11	1	10
Importance of product quality	21	4	—	17
Fixed costs	20	5	4	11
Rate of innovation	20	4	1	15
Importance of core activities	18	4	8	6
Importance of skill needs analysis	18	3	4	11
Profits	17	7	4	6
Importance of quality of suppliers	17	5	2	10
Importance of customer satisfaction	17	5	2	10
Performance	16	4	4	8
Competitor strength	15	1	—	14
Importance of global integration	15	4	1	10
Resources available	15	8	4	3
Variable costs	14	4	6	4
Union pressure against downsizing	14	5	—	9
Importance of product complexity	14	4	3	7
Importance of an IT strategy	14	—	2	12
Productivity	13	5	7	1
Importance of spreading risk	13	3	1	9
Importance of having access to world-class capabilities	9	—	—	9

to develop its IT function competitively. Other selective outsourcing referred frequently to 'non-core activities', but also to staff outsourcing in general, when staff of the required calibre could not be recruited profitably. This fits with Van Horn-Christopher's (1996) predictions of increasing 'staffing for profitability'.

Examining the reasons given for downsizing/outsourcing shows some tendency to accept traditional thinking that they will improve the airline's cost structure, e.g. 'need to downsize to improve productivity and profits', 'gain competitive advantage by reducing costs', 'to reduce fixed costs/variable costs/cost base' (used many times). In one 'status quo' scenario, where costs (including salaries), profits and market turbulence were all set to stay the same, outsourcing of non-value-added activities (along with investing in more routes and aircraft) was recommended as a 'growth/cost reduction strategy'. However, other recommendations show more strategic thinking, with some appreciation of the risks of losing company knowledge, e.g.

- outsource risky technologies to allow the airline to concentrate on strategic competencies and master leading-edge technologies;
- outsource parts of the value chain to providers who will give extra value, while preserving corporate knowledge;
- outsource less productive routes in order to improve routing efficiency;
- outsource activities which were no longer adding incremental value;
- (when skill needs and costs were increasing) downsize in order to be able to invest in training for the retained workforce.

The most common alternative strategy recommended when the factors in Table II occurred in a particular scenario was some type of partnership (joint venture, alliance, merger or collaboration),

Table III. Factors most frequently leading to a recommendation of downsizing/outsourcing

Type of recommendation/factor	Times this factor led to recommendation	
	No.	%
General downsizing or outsourcing (16 rules)		
Increased importance of business process re-engineering	3	19
Increase in competitor strength	3	19
Increased importance of global integration	3	19
Increased market turbulence	3	19
Decreased profits	3	19
Increase in importance of quality of suppliers	3	19
Increased importance placed on spreading of risk	3	19
Decrease in staff quality	3	19
Increased union pressure	3	19
IT outsourcing (8 rules)		
Increased importance of IT strategy	6	75
Increase in rate of innovation	4	50
Increased importance of skill needs analysis	4	50
Selective outsourcing (21 rules)		
Increase in importance of product quality	4	19
Decrease in staff quality	4	19
Increased importance of core activities	3	14
Increased importance placed on customer satisfaction	3	14
Increase in fixed costs	3	14
Decrease in productivity	3	14
Increase in importance of quality of suppliers	3	14
Decrease in resources available	3	14
All downsizing/outsourcing recommendations (45 rules)		
Increased importance of IT strategy	8	18
Increase in fixed costs	7	16
Decrease in staff quality	7	16
Increase in competitor strength	6	13
Decreased profits	6	13
Increase in importance of quality of suppliers	6	13
Decrease in resources available	6	13
Increased importance placed on spreading of risk	6	13
Increased importance of skill needs analysis	6	13
Increase in rate of innovation	5	11
Increased market turbulence	5	11

which is in line with current industry trends. These covered both partnerships with other airlines, to enhance market/route coverage or to access expertise which was lacking, and partnerships with suppliers. Where resources allowed, investment, in-house research and development, and training/ retraining of staff were recommended; but, in any situation where the scenario indicated limited resources, financial pressures, or a more uncertain or competitive marketplace, downsizing or outsourcing was the strategy of choice. In only one case was the opposite strategy of bringing outsourced functions back in-house recommended, in a highly competitive situation where the importance of product quality was increasing but customer satisfaction decreasing, and it was thought that closer control of quality was required to boost customer satisfaction.

The full list of recommendations was also scrutinized for more innovative strategies, some of which foreshadow more recent airline moves:

- collaborative new product development, flexible manufacturing, a preferred supplier network—to deal with increasing importance of innovation and increasing product complexity;
- business process re-engineering, retraining the freed staff in customer service skills (language, globalization)—when a stronger market orientation was required;
- sharing common services with other industry players;
- starting alliances with economy airlines outside Europe—where the importance of a new competitive structure is increasing;
- reviewing human resources policies, introducing a stock-option plan or profit-sharing—to deal with decreasing staff quality;
- team building training, developing brainstorming capabilities—where importance of customer satisfaction and the value chain is increasing;
- developing alliances with travel agencies, car hire companies, local tour operators, etc.—where importance of value chain is increasing;
- using low-cost hubs—where profits are decreasing but competition increasing;
- vertical integration through supplier acquisition, rewards/penalties for suppliers—to deal with decreasing supplier quality.

5.   IMPLICATIONS

5.1.   Implications for the Airline Industry

Discussion of the various scenarios resulted in the development of a database of suggested strategic options; some were very industry specific, whereas others were more general and need to be interpreted in terms relevant to the industry. Although participants did not come from the airline industry, their discussions produced several strategic ideas which have since emerged in reality, e.g. the founder of easyJet has set up easyRentacar, Air France has offered share options to employees, RyanAir announced in 2001 its plans for a continental hub at the minor Belgian airport of Charleroi. For the database to be of use to an airline, it would first require validation by company or industry experts. Also, the list of relevant factors should be checked for omissions, in the light of recent airline industry research; airlines may wish to add factors such as market growth rate and extent of environmental regulation. The ES's recommendations could then serve as a useful starting point for strategic discussion.

5.2.   Implications for Companies Considering the Use of Scenario Planning

The use of scenario planning in this context has highlighted both benefits and potential problems. The participants testified to the emergent benefits outlined by Bood and Postma (1997), in that they became more aware of environmental uncertainties and their possible implications, whereas discussion with peers from different backgrounds gave alternative perspectives, and stretched their thinking. The ES proved extremely useful as a quick method of recording complex information and allowing its retrieval, while the requirement to draft chosen strategies in terms of ES rules, with appropriate reasons, was useful in clarifying thinking and achieving group consensus. However, examination of the database shows many instances of 'circular reasoning', where one or more of the scenario conditions are repeated as a reason for the chosen action—this indicates some reliance on traditional 'rules of thumb'. The fact that this happened even when a facilitator was present some

of the time to encourage deeper thinking shows how easy it is to fall back unquestioningly on 'received wisdom', and highlights the importance of constantly challenging this practice.

5.3. Reliability and Validity

The reliability of the system and consequent methodology lies in the longitudinal approach taken (collected over 3 years on exactly the same factors and scenarios), as well as on the cross-sectional myriad of practitioner profiles who took part in the exercise (a considerable number of international managers from a multiplicity of cultures, industries, managerial functions, and educational and demographic backgrounds).

   The validity associated with method and the final ES prototype was measured through a validation procedure involving the presence each time (each year with different groups of participants) of two experts, one being an academic specializing in outsourcing/downsizing and the other being an industry expert, who have dissected the different features of scenario construction, strategic inputs/ recommendations and subsequent strategic reasoning. Furthermore, the elicitation of knowledge provided by the participants and the requests and allowance for the provision of self-designed scenario options have all provided the necessary stimulation and involvement from the part of the system users, which can also be seen as an important element underwriting the validity of the methodology and the resulting KBS.

5.4. Managerial Implications

Multiple scenario analysis is praised for the radically different stance it takes towards environmental uncertainties. Whereas trend-projecting forecasting techniques try to abandon any uncertainty by providing managers with only one forecast, multiple scenario analysis deliberately confronts managers with environmental uncertainties by presenting them with several, fundamentally different outlooks on the future. Scenarios focus attention on causal processes and crucial decision points can serve as a background for the evaluation and selection of strategies and can also provide a framework within which all the various factors and information can be more effectively and easily judged by the decision maker. Furthermore, and better than any other future-oriented tool, scenarios offer the possibility to integrate various kinds of data in a consistent manner. Good scenarios enlarge managers' understanding as to what is significant versus ephemeral. This allows for anticipation of the unexpected and provides for an early warning system. Organizations may even develop several contingency plans on the basis of the scenarios or an environment monitoring system. By exploring and anticipating the future, scenarios can help to identify major changes and strategic problems an organization will be facing in the future, as well as to generate strategic options to deal with them effectively.

   These findings reinforce the main objective of any ES, which is to act as a decision aid for a human problem solver and decision maker. This particular rule-based prototype could be intertwined with the more recent form of an ES in case-based reasoning, which uses previous cases similar to the current problem situation and uses them to find solutions. This form of ES allows the user to access the experience of experts and the database of previous cases to analyse the current cases and determine the outcome. Organizations are using ESs and KBSs in order to reduce the learning curves of processes. These systems can be used to build scenarios, test understanding of the industry and 'test' the internal knowledge of the managers. They are only as good as the designs and the quality of inputs, and should be used to guide the business in taking strategic actions. Reasoning from

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knowledge is an area in which computer programs can exceed human performance, as the computer does not contain a bias for information. The structure of knowledge is important when developing the ES, as knowledge that is not used over time in the hands of individuals can become distorted, 'corrupt' and forgotten. The advantage of a KBS is that the system can identify links between pieces of information well before an individual can make the connection, due to the unbiased nature of the system, as well as its ability to contain so much more information. Furthermore, the construction of small-scale applications such as this one, focusing on specific problem areas and using an ES shell, does not require extensive programming knowledge, and can be carried out concurrently with the discussion of scenarios. This allows speedy and effective development and validation.

6. CONCLUSIONS AND FURTHER RESEARCH

The main contribution of this research study can be encapsulated by stating that strategic decisions taken by senior managers can be enhanced and become more effective in terms of accuracy, goal-reaching capabilities and risk minimization, through the utilization of an environmental scanning methodology (in this case, scenario planning) coupled with the application of artificial intelligence (e.g. an ES). Moreover, the heuristics involved in strategic (long-term) decision making can benefit by the challenge confronting current mind sets, the stimulation of new assumptions, the triggering of innovative thought processes, and the predisposition to plan for contingencies, as well as a more concerted way to manage the intricacies of uncertainty.

Dedicated ESs similar to that detailed here have been applied to the oil, automotive and tourist industries and were also the subject of a workshop of top academics in Scotland that considered the use of environmental scanning and KBSs (Moutinho *et al.*, 2001).

The authors are currently undertaking another specific research study which seeks to apply an effectiveness measurement framework on a longitudinal basis. This effectiveness measurement process entails a comparative analysis between a hybrid context (managers of different backgrounds tackling scenarios, with their knowledge being encapsulated into an ES, as in the case of this paper) and a self-contained domain of expertise (managers working within the confines of the same organization and being exposed to exactly the same methodology). Obviously, in order to achieve a high level of correspondence, the context of the research of the two systems described above is the same, i.e. the global automobile industry in this case. The study will follow a census approach in terms of the sampling procedure. Outcome-based yardsticks (e.g. adoption rates related to the methodology) will be used to measure overall effectiveness.

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