Pergamon

0305-0548(94)00058-1

Computers Ops Res. Vol. 22, No. 7, pp. 731–743, 1995

0305-0548/95 $9.50 + 0.00

EVALUATING STRATEGIC ALTERNATIVES: AN ANALYTICAL MODEL

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(Received February 1994; in revised form July 1994)

Scope and Purpose—Strategic decision making is an extremely complex and difficult process. Hofer and Schendel note that most decision makers perform far better when they separate this process into distinct steps, address each step separately, and then combine the results at the end. In this paper we present a structured approach involving a specific step-by-step procedure designed to enhance the objectivity of the strategic decision making process. The proposed approach uses an analytical model to rank strategic alternatives based on their expected risks and returns. The information provided by the model can significantly support and supplement the decision maker's intuition.

Abstract—The amount of information involved in strategic decision making and the computational limitations of human decision makers makes strategy selection a difficult task. Various approaches from sheer intuition to computerized decision systems have been proposed for strategy selection. In this paper we present an analytical model which systematically evaluates a series of strategic alternatives by decomposing environmental opportunities and threats into internal, transactional, and contextual segments. Judgments about opportunities and threats are used to obtain two composite weighted scores measuring the risk and return associated with each strategic alternative. The proposed system puts the decision maker and the computer into an interactive partnership by providing a formal and systematic approach to strategy selection while using the computer to manage complex logical processes and vast amounts of information.

1. INTRODUCTION

The literature on strategic planning has presented many definitions of corporate strategy and corporate planning [1–3]. However, one of the oldest defintions of corporate strategy defines it as "the determination of the basic long-term goals and the objectives of an enterprise, and the adoption of courses of action and the allocation of resources necessary for carrying out these goals" [4, p. 13]. A company has only one corporate strategy which may incorporate several business strategies [5]. A business strategy refers to the choices made by a strategic business unit after examining risks and opportunities in the market, expected behavior of competitors, and the strengths and weaknesses of the unit [1]. There are many paradigms for strategic management [6]. Most of these paradigms agree that the strategic management process, both for corporate and business

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strategies, include goal formulation, environmental analysis, strategy formulation, strategy evaluation, strategy implementation, and strategy control. Most of these steps are complex and unstructured, some more than others. Therefore, it is essential to provide support to corporate management for effectively performing these tasks. It is almost impossible to develop an integrated system that can support all phases of strategic management. However, corporate management can be supported with computerized systems where the tasks are relatively structured. In this paper we present an analytical method to support strategy evaluation which incorporates environmental analysis. This method ranks strategic alternatives based on expected risks and returns, which can be of significant help to corporate management.

Lack of task structure, open-endedness of the strategic decision process [7, 8], and the vast amount of information needed to solve a problem have prompted many researchers to look for formal decision support tools for the strategy evaluation process [9]. Many such tools currently exist for strategy evaluation. Quantitative methods such as linear programming, game theory, Markov analysis, decision theory, and marginal analysis are among the commonly used methods in strategic evaluation. However, these methods are more appropriately used at the functional level, where the parameters are more specific and decision variables are more quantifiable. Other methods, e.g. Dialectic Polyicy Analysis (DPA) [10], Vulnerability Analysis (VA) [11], Corporate Simulation Models (CSM) [12–14], and Portfolio Models (PM) [15, 16] do not present a structured process for a systematic evaluation of the strategic alternatives. The literature presents two models that are similar in nature and intent to our model. These are Strategic Program Evaluation (SPE) [17, 18] and Quantitative Strategic Planning Matrix (QSPM) [19–21]. However, SPE and QSPM do not use comprehensive environmental analysis and risk associated with a potential strategy for evaluating potential alternatives. Moreover, these techniques use weights and subjective probabilities in the evaluation process, but do not provide any systematic procedure to develop such probabilities and weights.

The model presented in this paper promotes comprehensive scanning of the environment by decomposing it into internal, transactional, and contextual environments as suggested by many researchers [1, 17, 22–25]. A major advantage of decomposing the environment is that the relative weights of different environments can be specified independently of the relative weights of the factors within the environment. None of the existing analytical models explicitly use this concept of decomposing environmental data in the evaluation process. Our model uses environmental scanning data along with subjective probabilities and weights for opportunities and threats to rank strategic alternatives based on expected risks and returns.

2. MODEL DESCRIPTION

The strategic decision-making environment is defined as the set of relevant factors inside and outside the boundary of an organization that should be considered during the strategic decision making process. Environmental scanning is the process of seeking information about this environment. We decompose the environment into internal, transactional, and contextual environments. These environments are defined as (1) the *Internal Environment*: factors within the organization that are controllable; (2) the *Transactional Environment*: the layer closest to the organization including factors that have direct transactions with the organization on a regular basis and are semi-controllable; and (3) the *Contextual Environment*: factors outside the organization with which the organization interacts indirectly and are essentially uncontrollable.

A seven-step procedure, outlined below, systematically evaluates potential strategies by calculating the *strategic value* and the *strategic risk* associated with each alternative. The strategic value measures the desirability of an alternative whereas the strategic risk measures the possibility of not realizing the benefits associated with the alternative. Details for calculating these factors are presented in the next section. The seven steps are:

(1) Define environment-related weights.
(2) Identify opportunities and threats within each environment.
(3) Define weights associated with opportunities and threats.
(4) Develop subjective probabilities for each alternative.
(5) Calculate the strategic value for each alternative.

(6) Calculate the strategic risk for each alternative.
(7) Evaluate potential strategies.

Each of these steps are described below.

(1) Define environment-related weights

Calculate the subjective weights that represent the relative importance of internal, transactional, and contextual environments for the problem. Such weights have been assessed in the past directly by decision makers using a scale (e.g. ranging from 0 = unimportant to 1 = important) [20, 21]. We use the Analytic Hierarchy Process (AHP) [26–28] to calculate these weights. The advantage of using AHP is its capacity to measure the consistency of the decision maker while making pairwise comparisons of the relative importance of the environments. AHP is a widely used technique and an earlier survey listed well over 200 applications of AHP in the literature [29]. However, AHP can be easily substituted with any other appropriate method.

(2) Identify opportunities and threats within each environment

List all relevant opportunities and threats within each environment. These opportunities and threats are actually the potential outcomes of alternative strategies—not opportunities and threats in general. The internal environment consists of controllable factors within functional areas of a firm (e.g. production, personnel, and marketing) that represent internal opportunities and threats. Stevenson [30] presents a comprehensive list of possible opportunities and threats for any organization. The transactional environment includes opportunities and threats associated with competitors, customers, regulatory agencies, labor market, creditors, and suppliers which are largely semi-controllable. The contextual environment include mainly uncontrollable international, economic, political, legal, social, cultural, and demographic factors [25].

(3) Define weights associated with the opportunities and threats

Compute the weights associated with each opportunity and threat. Again, AHP is used to simplify the estimation process by confining the estimates to pairwise comparisons of factors within each environment. The measure of inconsistency provided by AHP allows for the examination of inconsistent priorities.

(4) Develop subjective probabilities for each alternative

Estimate the probability of occurrence for each potential opportunity and threat. Such subjective assessments are often used in strategic management [31]. We use probabilistic phrases, like "impossible", 'possible", and "certain" to elicit required information and then convert these into numeric probabilities as suggested by many researchers [32–35]. These varbal probabilistic expressions and their perceived probability estimates are given in Table 1. Alternatively, the decision maker may use numeric probabilities instead of the probabilistic phrases. We assume that the subjective probability associated with a factor (which represents the probability of realizing the situation) is binomial. Binomial probabilities are commonly used in strategic decision making since the decision maker can simplify the problem by analyzing possible outcomes as either occurring or not occurring. For example, Schoemaker [36] assigns binomial probabilities to factors such as

Table 1. Verbal probabilistic expressions and perceived probability estimates

Verbal expression	Probability
Impossible	0.00
Small possibility	0.10
Small chance	0.20
Somewhat doubtful	0.30
Possible	0.40
Toss-up	0.50
Somewhat likely	0.60
Likely	0.70
Very likely	0.80
Quite certain	0.90
Certain	1.00

"Dow Jones Industrial Average falling below 1500 mark by 1990" or "Election of a Democrat as U.S. president by 1990". Vickers [37] also assigns binomial probabilities to similar factors such as "Japanese car manufacturers gain at least 30% of the European market share" and "The incorporation of East Europe into Europe by 1993" in order to examine the future of European automobile industry. The main motivation for using the binomial probabilities is to reduce the complexity of the model.

(5) Calculate the strategic value for each alternative

Calculate the strategic value of each alternative by using the algebraic model. Relevant details of the model are presented in the next section. The strategic value of an alternative represents the attractiveness of an alternative calculated by subtracting the *Total Threat Value* of the alternative from its *Total Opportunity Value*. These two values are in turn calculated by summing the multiplication of the relative weight of each type of environment to the relative weight of each factor within that environment and the subjective probability of that factor for the selected alternative. The higher the strategic value the more attractive that alternative will be.

Table 2. Representation of the relevant information used in the model

Opportunities				
		Probability of occurrence (P_{uij}^m) $m=1, 2, \ldots, q$		
Subjective weight of the environment W_{ui}	Subjective weight of the factor F_{uij}	$m=1$	$m=2$	$m=q$
W_{u1}	F_{u11}	P_{u11}^1	P_{u11}^2	P_{u11}^q
	F_{u12}	P_{u12}^1	P_{u12}^2	P_{u12}^q
	...	...	.....	...
	F_{u1j}	P_{u1j}^1	P_{u1}^2	P_{u1j}^q
W_{u2}	F_{u21}	P_{u21}^1	$P_{u21}^{2\prime}$	P_{u21}^q
	F_{u22}	P_{u22}^1	P_{u22}^2	P_{u22}^q
	...	...	...	...
	F_{u2j}	P_{u2j}^1	P_{u2j}^2	P_{u2j}^q
W_{u3}	F_{u31}	P_{u31}^1	P_{u31}^2	P_{u31}^q
	F_{u32}	P_{u32}^1	P_{u32}^2	P_{u32}^q
	...	...	...	...
	F_{u3j}	P_{u3j}^1	P_{u3j}^2	P_{u3j}^q
Total opportunity value (U^m)		U^1	U^2	U^q
Threats				
		Probability of occurrence (P_{tij}^m) $m=1, 2, \ldots, q$		
Subjective weight of the environment W_{ti}	Subjective weight of the factor F_{tij}	$m=1$	$m=2$	$m=q$
W_{t1}	F_{t11}	P_{t11}^1	P_{t11}^2	P_{t11}^q
	F_{t12}	P_{t12}^1	P_{t12}^2	P_{t12}^q
	...	...	...	...
	F_{t1j}	P_{t1j}^1	P_{t1j}^2	P_{t1j}^q
W_{t2}	F_{t21}	P_{t21}^1	P_{t21}^2	P_{t21}^q
	F_{t22}	P_{t22}^1	P_{t22}^2	P_{t22}^q
	...	...	...	...
	F_{t2j}	P_{t2j}^1	P_{t2j}^2	P_{t2j}^q
W_{t3}	F_{t31}	P_{t31}^1	P_{t31}^2	P_{t31}^q
	F_{t32}	P_{t32}^1	P_{t32}^2	P_{t32}^q
	...	...	...	...
	F_{t3j}	P_{t3j}^1	P_{t3j}^2	P_{t3j}^q
Total value (T^m)		T^1	T^2	T^q
Strategic value (V^m)		V^1	V^2	V^q
Standard deviation (S^m)		S^1	S^2	S^q
Strategic value per unit of risk (E^m)		E^1	E^2	E^q

(6) Calculate the strategic risk for each alternative

Calculate the strategic risk of each alternative by using the algebraic model presented in the next section. This risk is a composite measure of the spread of the weights and probabilities associated with each factor within an environment. Higher spread represents greater risk of not realizing the benefits associated with that alternative.

(7) Evaluate potential strategy

Compute the strategic value per unit of risk of an alternative by dividing the strategic value by its strategic risk. Higher strategic value increases the desirability, whereas higher risk decreases the desirability of that alternative. Therefore, we choose the alternative with the highest strategic value per unit of risk assuming that the decision maker is risk neutral. If the decision maker is not risk neutral, a utility function may be developed to select the most desirable alternative. Strategic value per unit of risk (reciprocal of the coefficient of variation) is also a commonly used measure for selection of alternatives in other areas (e.g. portfolio selection [38, 39]). All the weights, probabilities, and values used in our model are organized in a tabular form and presented in Table 2.

3. MODEL FORMULATION

To formulate the algebraic model let us assume:

E^m = strategic value per unit of risk ($m = 1, 2, \ldots, q$)
V^m = total weighted strategic value of the mth strategic alternative ($m = 1, 2, \ldots, q$)
S^m = standard deviation associated with the mth strategic alternative derived from all opportunity and threat factors in all three environments ($m = 1, 2, \ldots, q$)
U^m = total weighted opportunity value of the mth strategic alternative ($m = 1, 2, \ldots, q$)
T^m = total weighted threat value of the mth strategic alternative ($m = 1, 2, \ldots, q$)
V_u^m = variance of the value of the mth strategic alternative derived from all opportunity factors in all three environments ($m = 1, 2, \ldots, q$)
V_t^m = variance of the value of the mth strategic alternative derived from all threat factors in all three environments ($m = 1, 2, \ldots, q$)
W_{u_i} = The ith environment opportunity associated weight ($i = 1$, 2, and 3)
W_{t_i} = the ith environment threat associated weight ($i = 1$, 2, and 3)
$R_{u_{ij}}$ = the jth factor opportunity associated weight for the ith environment ($j = 1, 2, \ldots, N_{u_i}$; and $i = 1$, 2, and 3)
$R_{t_{ij}}$ = the jth factor threat associated weight for the ith environment; ($j = 1, 2, \ldots, N_{t_i}$; and $i = 1$, 2, and 3)
$P_{u_{ij}}^m$ = the mth opportunity associated probability of occurrence of the jth factor in the ith environment ($m = 1, 2, \ldots, q$; $j = 1, 2, \ldots, N_{u_i}$; and $i = 1$, 2, and 3)
$P_{t_{ij}}^m$ = the mth threat associated probability of occurrence of the jth factor in the ith environment ($m = 1, 2, \ldots, q$; $j = 1, 2, \ldots, N_{t_i}$; and $i = 1$, 2, and 3)
N_{u_i} = number of opportunity factors in the ith environment ($i = 1$, 2, and 3)
N_{t_i} = number of threat factors in the ith environment ($i = 1$, 2, and 3)

Assuming that $i = 1$–3 represent the internal, transactional and contextual environments, respectively, we find the most attractive strategic value per unit of risk for the mth strategic alternative by maximizing E^m. The higher the E^m, the more attractive the alternative. Alternatives with $E^m \leqslant 0$ should be viewed unfavorably since their total threat value equals or outweighs their total opportunity value. Generally, for an alternative to be acceptable, its total opportunity value must exceed its total threat value. Therefore, our objective is to maximize:

$$E^m = \frac{V^m}{S^m} \tag{1}$$

where

$$V^m = U^m - T^m \tag{2}$$

$$U^m = \sum_{i=1}^{3} W_{u_i} \left(\sum_{j=1}^{N_{u_i}} R_{u_{ij}} P_{u_{ij}}^m \right) \tag{3}$$

$$T^m = \sum_{i=1}^{3} W_{t_i}\left(\sum_{j=1}^{N_{t_i}} R_{t_{ij}} P^m_{t_{ij}}\right) \tag{4}$$

$$S^m = \sqrt{V^m_u + V^m_t} \tag{5}$$

$$V^m_u = \sum_{i=1}^{3} W_{u_i} \sum_{j=1}^{N_{u_i}} [(P^m_{u_{ij}} - U^m)^2 R_{u_{ij}}] \tag{6}$$

$$V^m_t = \sum_{i=1}^{3} W_{t_i} \sum_{j=1}^{N_{t_i}} [(P^m_{t_{ij}} - T^m)^2 R_{t_{ij}}] \tag{7}$$

$$\sum_{i=1}^{3} \mathrm{W}_{u_i} = 1 \tag{8}$$

$$\sum_{i=1}^{3} W_{t_i} = 1 \tag{9}$$

$$\sum_{j=1}^{N_{u_i}} R_{u_{ij}} = 1 \tag{10}$$

$$\sum_{j=1}^{N_{t_i}} R_{t_{ij}} = 1 \tag{11}$$

$$0 \leqslant P^m_{u_{ij}} \leqslant 1 \tag{12}$$

$$0 \leqslant P^m_{t_{ij}} \leqslant 1. \tag{13}$$

4. A CASE STUDY†

To illustrate the procedure and its utility we present a case study in this section. The management of the company was requested to use this model as an additional input to their existing methods for planning. The company is a large multi-billion dollar manufacturer and fabricator of industrial steel components. During the 1970s the company grew from one facility to 10 plants throughout the Mid-Atlantic and Mid-West regions of the U.S.A. During this period the labor force increased from 1500 to 15,000 and the number of administrative and sales personnel increased from 500 to 1800. However, since the mid 1980s the company has found itself in a faltering industry with high labor costs, a recessionary economy, a tremendous increase in foreign competition, and a dried up credit market. The company had a net loss for the past 3 years of approx. $10 billion, which forced top management to take drastic action. The board of directors decided that the Company must return to a manageable size that can become profitable. The board also decided that this structural change should also include modernization of the production process to increase production and production efficiency. This change was to be conducted with minimal disruption throughout the corporation and each facility's external environment (e.g. customers, and communities).

After an extensive study, management identified four plausible alternatives: (1) furloughing of employees, (2) an across the board wage and benefit reduction, (3) an early retirement incentive program, and (4) an employee buy-out of the current stockholders. *Furloughing of employees* would involve 25% of the unionized work force, 30% of the administrative personnel and none of the sales force. Plant modernization significantly reduces the need for manual labor. Also, the current production level could be curtailed due to the recession. This will also reduce the need for supervisory and administrative support. This option was expected to save the company $50 million within 2 years. An *across the board wage and benefits reduction* could be accomplished through a 1% reduction for every $10,000 in salary. The benefit package would be modified through an increase in the medical co-pay by $250 per year, per family. This was expected to save the company $20 million the first year and $15 million per year during the second and third years. The *early retirement incentive program* would be offered to those employees with 20 years of service. In addition to receiving their pension they would be given an extra $10,000 plus other incentives based on their age and tenure with the company. This plan would be the most expensive during the initial year

†Selected data has been omitted or changed to protect the anonymity of this company.

costing $10 million. However, the savings during subsequent years would be $5 million per year for the next 10 years. The *employee buy-out* would allow the employee unions to purchase all outstanding common shares of the company at a rate no less than 5% above the present market value at the time of the buy. This alternative would not cost the company any capital, but the current owners would have to give up total control of the corporation. To evaluate the alternatives the following **opportunities** were considered:

Internal factors

WBR (reduction of wage and benefits by 15%): WBR would reduce labor expense and create a sense of stability among employees because their compensation would not be drastically altered in future. This is deemed as the most important factor for the management.
PRD (increase in productivity by 10% per year): when fully implemented, the new production process could increase productivity by 10% per year.
OEQ (annual increase in owners' equity of 10%): it is expected that with the planned corporate restructuring a return to an annual increase in owners' equity is achievable.
SKL (increase in employee skill level): plant modernization requires increasing the skill level of workers and providing greater opportunities for career advancement. Although this is important, management deemed the necessity of regaining the stockholders confidence as more important.

Transactional factors

CON (the ability to sub-contract 40% of prefabricated material): if 40% of the production of pre-fabricated material were sub-contracted the company would reduce its production and inventory costs by approx. 20%.
STK (increased stock price by a minimum of 15%): the company must achieve greater stockholder confidence in management's ability. An alternative that could increase the stock price by a minimum of 15% would promote such a move.
SUP (improved relationships with suppliers and lenders): all decisions must try to improve the company's relationship with its suppliers and creditors. This will give the company a chance to renegotiate better terms on accounts payable and lender interest rates.
PRC (a merchanside price reduction of 5%): the company should reduce the price of products by at least 5% to stay competitive. This is not considered to be a favorable move.

Contextual factors

DEF (an increase in defense contracts): it was expected that the Defense Department, in the next 60 months, would be awarding contracts worth an estimated $200 billion, of which $75 billion would be for steel products.
RED (an increase in commercial real estate development): an increase in commercial real estate development and modernization of the production process would enable the company to have a greater competitive edge in the bidding.
GLT (a 25% glut of steel products worldwide): due to the recession there is a glut of steel products of approximately 25% above normal inventories. This is viewed as positive if the need to reduce output increases.
ENV (ability to meet mandated environmental constraints): the U.S. steel industry must meet or exceed mandated environment constraints by the year 2000 which will be attained through a modernization program.

The following **threats** were also considered for evaluating the alternatives:

Internal factors

STR (probability of labor strikes): in corporate restructuring decisions, labor strikes or a slowdown could be detrimental. This threat should not be viewed lightly as it is almost a certainty with some of the alternatives.
REX (increase in relocation expenses): depending on the options selected, management could be faced with the expense of relocating the remaining displaced employees. It is estimated this could cost in the area of $5 million.

RET (cost of employee retraining): the budget for the employee development department must be increased by 50% to ensure sufficient training. Although this is costly, the ability to do this would be beneficial to the future of the Company.
PLF (increased pilferage by 5%): it is estimated that there could be as much as 5% chance of increasing shrinkage due to pilfering. Interviews and analysis of other companies have indicated employees reraliate when mass changes occur and a prime method is via pilfering.
TOV (employee turnover): corporate structural changes can affect employee morale. The question must be asked: will the employees be so frustrated and disenchanted that turnover increases?
COM (effect upon internal communications): the effect upon the communication from management down to the employee and conversely, bottom up communications must be contemplated. In times of restructuring communication flows can be thwarted. This can have a damaging affect on productivity and employee morale.

Transactional factors

LIT (increased litigation costs): when a company of this stature has a substantial reduction of labor it most certainly will be followed by an increase in litigation and arbitration. It is projected that costs for this would be astronomical.
UWF (funding of union budgets and penalty assessment for workforce reduction): according to current contract the Company is obligated to fund the budgets of each local representing the employees by a minimum of 30%. In addition, for reduction in union employees $>3\%$ of the current level at contract signing, the company is assessed a penalty of 15% of the displaced employees' base salaries. This could be a financial drain on the Company regardless of the union workforce.
INS (increase in insurance expenses by 5%): research of similar organizational climates found a correlation between labor reduction and increased insurance rates. It was found that insurance rates increased by approx. 5% following any major change in employee composition. This could be caused by an increase in theft, fire and medical disability.
ESP (corporate espionage and sabotage): research also indicates that corporate espionage and sabotage can during and after a massive change such as this undertaking. It is anticipated that certain options could result in such action.

Contextual factors

EMP (post employment costs in excess of a 20% increase): the cost of post employment expenditures would exceed 20% above previous estimates. This estimated increase would add significantly to the Company's expenses. This includes unemployment compensation insurance, long-term pension costs and medical expenses.
ACC (changes in accounting procedures and tax computation): additional expenditures are expected with changes in accounting procedures and tax computation mandated by the Securities and Exchange Commission (SEC) and the Internal Revenue Services (IRS). These new conditions adversely affect the amount and timing of tax liabilities, recognition of expenses and the amortization of certain long term investments.
PUB (public perception of the company): company image among the general public and local governments is an important factor for decisions on tax abatements and zoning ordinances. Additionally the industry thrives on public works projects and therefore the company cannot afford to alienate itself.
ECN (ecomomic decline of approx. 10%): according to most economists our economy is expected to continue its decline an additional 10% within the next 2 years. Therefore any corporate structural change must incorporate adjustments to counteract this expected decline. Should the economy not fall as predicted, the Company will be in much better financial condition. Optimism prevails.
TAX (a 10% tax reduction on imported steel): this tax reduction has recently been implemented on imported steel. The effects of this are uncertain as the legislation may be reversed due to policital pressures.

The pairwise comparison of these opportunities and threats were carried out to determine their

relative importance in the decision making process. The result of this process is presented in Tables 3 and 4. We then estimate the probability of occurrence for each of the factors listed above for each of the four alternatives being considered. These probabilities numerically symbolize the degree to which a factor is most likely to occur. For example, there is a 90% chance of realizing the targeted reduction of wages and benefits if the company furloughs its employees. However, there is only an 80% chance of achieving this target if the company adopts any of the other three alternatives. Next, using equation (3), we calculate the total weighted opportunity value (U^m) of the four strategic alternatives. As it is shown below, furloughing of employees (alternative 1) has the highest opportunity value:

$$U^1 = 0.727 \qquad U^2 = 0.587 \qquad U^3 = 0.674 \qquad U^4 = 0.446.$$

Similarly, using equation (4), we calculate the total weighted threat value (T^m) of the four alternatives:

$$T^1 = 0.612 \qquad T^2 = 0.428 \qquad T^3 = 0.381 \qquad T^4 = 0.349.$$

An employee buy-out of the current stockholders (alternative 4) has the lowest threat value. Using equation (2), we then calculate the total weighted strategic value (V^m) of the four alternatives:

$$V^1 = 0.115 \qquad V^2 = 0.159 \qquad V^3 = 0.293 \qquad V^4 = 0.097.$$

An early retirement incentive program (alternative 3) has the best strategic value followed by an across the board wage and benefit reduction (alternative 2). Next, using equation (6), we calculate the variance of the opportunity value (V_u^m) of each alternative:

$$V_u^1 = 0.408 \qquad V_u^2 = 0.056 \qquad V_u^3 = 0.021 \qquad V_u^4 = 0.086.$$

Similarly, using equation (7), we calculate the variance of the threat value (V_t^m) of each strategic alternative:

$$V_t^1 = 0.040 \qquad V_t^2 = 0.098 \qquad V_t^3 = 0.095 \qquad V_t^4 = 0.066.$$

Table 3. Pairwise comparison matrices (opportunities)

Environmental Comparisons inconsistency ratio = 0.070				
	Internal	Transactional	Contextual	Relative weight
Internal	1	3	4	0.614
Transactional	1/3	1	3	0.268
Contextual	1/4	1/3	1	0.118

Internal Factors inconsistency ratio = 0.090					
	WBR	PRD	OEQ	SKL	Relative weight
WBR	1	3	4	4	0.517
PRD	1/3	1	3	3	0.260
OEQ	1/4	1/3	1	3	0.142
SKL	1/4	1/3	1/3	1	0.081

Transactional Factors inconsistency ratio = 0.045					
	CON	STK	SUP	PRC	Relative weight
CON	1	3	4.5	5	0.551
STK	1/3	1	2	3	0.226
SUP	1/4.5	1/2	1	3	0.148
PRC	1/5	1/3	1/3	1	0.075

Contextual Factors inconsistency ratio = 0.060					
	DEF	RED	GLT	ENV	Relative weight
EEF	1	2	3	4	0.451
RED	1/2	1	3	3	0.304
GLT	1/3	1/3	1	3	0.160
ENV	1/4	1/3	1/3	1	0.085

Table 4. Pairwise comparison matrices (threats)

Environmental Comparisons inconsistency ratio = 0.051				
	Internal	Transactional	Contextual	Relative weight
Internal	1	2	3.5	0.539
Transactional	1/2	1	3.5	0.339
Contextual	1/3.5	1/3.5	1	0.122

Internal factors inconsistency ratio = 0.089							
	STR	REX	RET	PLF	TOV	COM	Relative weight
STR	1	3	3	4	3	5	0.374
REX	1/3	1	2	4	3	3	0.225
RET	1/3	1/2	1	4	3	3	0.180
PLF	1/4	1/4	1/4	1	3	3	0.100
TOV	1/3	1/3	1/3	1/3	1	2	0.071
COM	1/5	1/3	1/3	1/3	1/2	1	0.050

Contextual Factors inconsistency ratio = 0.021					
	LIT	UWF	INS	ESP	Relative weight
LIT	1	2	3	5	0.469
UWF	1/2	1	3	4	0.315
INS	1/3	1/3	1	2	0.137
ESP	1/5	1/4	1/2	1	0.079

Transactional Factors inconsistency ratio = 0.038						
	EMP	ACC	PUB	ECN	TAX	Relative weight
EMP	1	2	3	4	3	0.392
ACC	1/2	1	2	4	4	0.285
PUB	1/3	1/2	1	2	2	0.149
ECN	1/4	1/4	1/2	1	2	0.096
TAX	1/3	1/4	1/2	1/2	1	0.078

Using equation (5), we then calculate the standard deviation (S^m) associated with each alternative:

$$S^1 = 0.297 \qquad S^2 = 0.393 \qquad S^3 = 0.340 \qquad S^4 = 0.390.$$

We then use equation (1) and calculate the strategic value per unit of risk (E^m) for each of the four alternatives:

$$E^1 = 0.387 \qquad E^2 = 0.404 \qquad E^3 = 0.861 \qquad E^4 = 0.248.$$

As it is shown, an early retirement incentive program (alternative 3) has the highest strategic value per unit of risk ($E^3 = 0.861$) followed by an across the board wage and benefit reduction (alternative 2). The above information is presented in Table 5. Since these alternatives were considered mutually exclusive, the early retirement incentive program (alternative 3) is considered to be the most attractive alternative.

5. CONCLUSION AND FUTURE RESEARCH DIRECTIONS

This model has been implemented using a microcomputer, but the interaction with AHP software is not automatic. However, such interaction can be easily accomplished by professionals. Computerized support for summarizing a vast amount of information is of obvious help to management. This model also provides managers with a "what-if" capability to understand the sensitivity of various factors in the model. For example, the probability of a strike in the event of a wage reduction was considered "most likely" (70%). However, management can find out the impact of potential underestimation of the threat by changing this possibility to a certainty (100%) and recalculating the strategic values per unit of risk of different alternatives. Such a capability is

Table 5. Summarized comparison of the strategic alternatives

	Environment weight	Factor weight	LAYOFF	WAGE	RETIRE	EMP OWN
		Opportunities				
Internal factors	0.614					
WBR		0.517	0.90	0.80	0.80	0.80
PRD		0.260	0.40	0.70	0.70	0.40
OEQ		0.142	0.60	0.50	0.50	0.10
SKL		0.081	0.60	0.10	0.90	0.20
Transactional factors	0.268					
CON		0.551	1.00	0.30	0.50	0.10
STK		0.226	0.60	0.60	0.70	0.20
SUP		0.148	0.70	0.70	0.40	0.80
PRC		0.075	0.90	0.90	0.60	0.20
Contextual factors	0.118					
DEF		0.451	0.40	0.10	0.80	0.40
RED		0.304	0.60	0.60	0.50	0.20
GLT		0.160	0.80	0.70	0.60	0.80
ENV		0.085	0.70	0.60	0.40	0.30
Total opportunity value			0.727	0.587	0.674	0.446
		Threats				
Internal factors	0.539					
STR		0.374	0.80	0.70	0.10	0.20
REX		0.225	0.40	0.90	0.20	0.40
RET		0.180	0.70	0.10	1.00	0.20
PLF		0.100	0.60	0.80	0.20	0.80
TOV		0.071	0.30	0.60	0.30	0.20
COM		0.050	0.90	0.20	0.80	0.10
Transactional factors	0.339					
LIT		0.469	0.60	0.10	0.20	0.80
UWF		0.315	0.70	0.20	0.70	0.10
INS		0.137	0.80	0.30	0.40	0.20
ESP		0.079	0.40	0.80	0.20	0.60
Contextual factors	0.122					
EMP		0.392	0.60	0.10	0.90	0.10
ACC		0.285	0.00	0.20	0.40	0.30
PUB		0.149	0.40	0.30	0.30	0.20
ECN		0.096	0.20	0.10	0.20	0.10
TAX		0.078	1.00	0.60	0.10	0.40
Total threat value			0.612	0.428	0.381	0.349
Strategic value			0.115	0.159	0.293	0.097
Standard deviation			0.297	0.393	0.340	0.390
Strategic value per unit of risk			0.387	0.404	0.861	0.248

of significant help to top managers who find it very difficult to accurately estimate the future events. If the "what if" analysis point only to a few factors whose accurate estimates are critical to the decision then management can divert their attention and resources to get precise estimates of the likelihood of occurrence of those factors. Though such capabilities are present in mathematical programming, they are not built into most of the strategic evaluation models. This is a valuable contribution of this model to the strategic management literature. This model also stratifies the information requirements into a hierarchy that simplifies information input and helps focus decision makers on a small area of the larger problem. This can help divide the problem into sub-problems for seeking input from different managers.

The current model deals with the decision-making process of one particular decision maker. In reality, such decisions are never made by a single decision maker. The next step in enhancing the model is to extend the model's capability to handle input from multiple decision makers. Although individual and group decision making are interrelated, there is no unique and compelling answer to group choice problems [40]. A simple answer is to average the decision makers' strategic values per unit of risk. The alternatives could then be ranked according to their average strategic value per unit of risk. While this is a simple solution, it may not be desirable. Delphi framework can be used with the approach proposed in this paper to obtain a consensus from a group of decision makers (see [41]). Initially, each group member using the model develops his or her individual rankings. After several rounds of Delphi, the decision makers meet to compare and provide the rationale for their rankings. The group as a whole must then compromise and reach a consensus.

Beck and Lin [42] have proposed two straightforward methods, the maximize agreement heuristic and the minimize regret heuristic, for approximating the optimal consensus rankings of a group of decision makers. Both methods are easy to implement and provide excellent consensus ranking solutions [43]. Given the rankings provided by a group of decision makers, these methods can identify consensus ordering that reflect collective decision maker agreement. Either method can be used with the approach proposed in this paper. In addition, several researchers have presented other more sophisticated consensus ranking techniques appropriate for practical implementations [43–45]. Finally, the current enhancements in group decision support systems provide a wide range of options to extend the model in the future. Extending this model to a multi-user environment and to permit the automatic capture of knowledge from previous decision-making sessions can significantly enhance the model's capabilities.

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