Table 5: Pairwise comparison matrices (threats).

Internal Environment (Inconsistency Ratio = .045)

	RTC	IEX	RDE	LAS	Relative Weight
RTC	1	3	5	7	.568
IEX	1/3	1	3	4	.252
RDE	1/4	1/3	1	2	.121
LAS	1/5	1/4	1/2	1	.059

Task Environment (Inconsistency Ratio = .020)

	NPH	RIS	SAD	CSU	ILC	Relative Weight
NPH	1	2	3	5	7	.429
RIS	1/2	1	3	4	6	.303
SAD	1/3	1/3	1	2	4	.143
CSU	1/5	1/3	1/2	1	2	.079
ILC	1/7	1/6	1/4	1/2	1	.046

General Environment (Inconsistency Ratio = .037)

	TMC	RIP	RGR	Relative Weight
TMC	1	3	5	.637
RIP	1/3	1	3	.258
RGR	1/5	1/3	1	.105

internal environment were used to show how the revised weights were calculated in the Microsoft Excel spreadsheet. Consider m=1, 2, 3, 4, and 5 (alternatives A, B, C, D, and E); j=1, 2, 3, 4, and 5 (opportunity factors ROS, IIP, ESL, COM, and ICS); i=1 (internal environment); and $p^m_{u_{ij}}$ representing the probability of occurrence of five alternatives on five opportunity factors in the internal environment. First the entropy measure of the jth opportunity factor, $e(p_{u_{ij}})$, was calculated. Table 7 contains the information necessary to calculate $e(p_{u_{ij}})$.

$$\text{Given } e_{\max} = \ln 5 = 1.6094, \text{ by setting } K = 1/e_{\max} = .6213, \quad \text{for } j = 1:$$

$$e(p_{u_{11}}) = -(.6123)[.281(\ln .281) + .281(\ln .281) + .031(\ln .031) + .188(\ln .188) + .219(\ln .219)].$$

In summary,

$$e(p_{u_{11}}) = .912,\ e(p_{u_{12}}) = .910,\ e(p_{u_{13}}) = .863,\ e(p_{u_{14}}) = .969,\ e(p_{u_{15}}) = .952,$$

Table 6: Summarized comparison between strategic alternatives.

	Environmental Weight	Overall Weight	Risk Aversion	Alternatives A	B	C	D	E
Opportunities								
ROS		.480	.8000	.90	.90	.10	.60	.70
IIP		.265	.7000	.70	.80	.10	.70	.40
ESL	.637	.203	.0040	.60	.10	.40	.90	.20
COM		.027	.0010	.40	.80	.50	.80	.40
ICS		.025	.0900	.80	.80	.30	.90	.40
HQC		.447	.6000	.80	.90	.10	.70	.80
PHR		.193	.0700	.40	.20	.70	.80	.70
IMS	.258	.109	.9000	.20	.30	.60	.70	.30
MCB		.154	.8000	.20	.10	.10	.80	.50
IOS		.097	.0600	.20	.10	.10	.60	.80
RGC		.127	.0020	.90	.70	.90	.70	.90
GFA	.105	.415	.0500	.70	.70	.10	.80	.70
AGL		.458	.0080	.20	.10	.60	.80	.80
Risk-adjusted Opportunity Value				.635	.591	.206	.658	.522
Threats								
RTC		.114	.0001	.40	.60	.40	.70	.50
IEX	.079	.445	.0030	.20	.10	.60	.80	.90
RDE		.316	.0070	.80	.90	.10	.30	.10
LAS		.125	.0800	.10	.90	.80	.20	.30
NPH		.367	.8000	.10	.30	.40	.40	.10
RIS		.480	.0900	.20	.40	.90	.20	.10
SAD	.659	.039	.1000	.10	.10	.10	.20	.10
CSU		.064	.7000	.20	.30	.10	.40	.10
ILC		.050	.8000	.10	.10	.10	.30	.40
TMC		.729	.0400	.10	.10	.30	.20	.80
RIP	.262	.129	.6000	.20	.10	.10	.30	.40
RGR		.142	.5000	.10	.10	.10	.40	.80
Risk-adjusted Threat Value				-.183	-.317	-.522	-.337	-.335
Risk-adjusted Strategic Value				.452	.274	-.316	.321	.187

and E, the sum of all $e(p_{u_{ij}})$, was 4.606. Substituting in the formula for $F_{u_{ij}}$, the intrinsic weights worked out to be

$$F_{u_{11}} = .223, F_{u_{12}} = .228, F_{u_{13}} = .349, F_{u_{14}} = .078, \text{ and } F_{u_{15}} = .123.$$

The initial weights ($w_{u_{ij}}$) had already been estimated by the DM as:

$$w_{u_{11}} = .484, w_{u_{12}} = .262, w_{u_{13}} = .131, w_{u_{14}} = .077, \text{ and } w_{u_{15}} = .046.$$

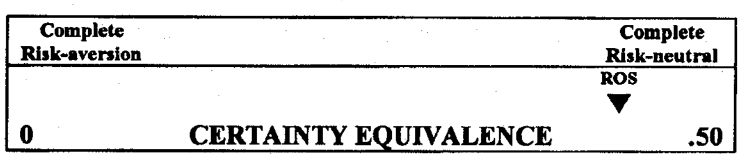
Table 7: Information necessary for calculating $e(p_{u_{ij}})$.

	$p^m_{u_{ij}}$						$p^m_{u_{ij}}/p_{ij}$				
Factor	A	B	C	D	E	P_{ij}	A	B	C	D	E
ROS	.90	.90	.10	.60	.70	3.20	.281	.281	.031	.188	.219
IIP	.70	.80	.10	.70	.40	2.70	.259	.296	.037	.259	.148
ESL	.60	.10	.40	.90	.20	2.20	.273	.045	.182	.409	.091
COM	.40	.80	.50	.80	.40	2.90	.138	.276	.172	.276	.138
ICS	.80	.80	.30	.90	.40	3.20	.250	.250	.094	.281	.125

Comparing $w_{u_{ij}}$ and $F_{u_{ij}}$, it was clear that the small $w_{u_{13}}$=can be offset by a relatively large $F_{u_{13}}$. Substituting into the formula for $\hat{F}_{u_{ij}}$, the overall importance weights were obtained:

$$\hat{F}_{u_{11}}=.480,\ \hat{F}_{u_{12}}=.265,\ \hat{F}_{u_{13}}=.203,\ \hat{F}_{u_{14}}=.027, \text{ and } \hat{F}_{u_{15}}=.025.$$

Next the DM's risk-aversion constant for the opportunities and threats was measured using the CE method (step 7). The DM was provided with simple exercises in order to measure his risk-aversion constant towards each opportunity and threat. For example, consider Reduction of Staff (ROS) by 2 percent. The DM was asked to provide his CE for a 50-50 lottery between 0 and 1, where 1 represents the occurrence and 0 represents the non-occurrence of ROS. Given the expected value of .50(1)+.50(0)=.50 for this lottery, the DM was asked to provide his CE between 0 and .50. Note that 0 represents complete risk-aversion ($r=\infty$) and .50 represents complete risk-neutrality ($r=0$). Given the DM's CE of .40 for this lottery and his utility function of $u(.4)=1/r(1-e^{-.4r})$, his risk-aversion constant for ROS was equal to .8. A computer program was used to graphically measures the risk-aversion constant for the opportunities and threats. The program presented the DM with the 50-50 ROS lottery described earlier. Using the graphical scale shown below, the DM could move away from the default complete risk-neutral position (CE=.50, r=0) towards complete risk-aversion position (CE=0, $r=\infty$).



Once the DM placed the cursor at the desired position (CE=.4), the program automatically calculated the risk-aversion constant (r=.8). This procedure was repeated until the risk aversion constants for all opportunities and threats were determined.

These risk-aversion constants along with the overall weights of each factor, and the subjective probabilities are listed as a part of Table 6.

The last step (step 8) was to calculate the risk adjusted strategic value for each alternative using equations (6), (7), and (8). This step was also totally automated, and the DM was only provided with the risk-adjusted opportunity, threat, and strategic values for each alternative. In addition, the system provided the DM with a rank order of the alternatives according to their risk-adjusted strategic values. A spreadsheet was used to manipulate the previously stored weights, probabilities, and risk-aversion constants. Comparisons of the risk-adjusted strategic values indicated the relative desirability of one alternative over others. As shown in Table 6, alternative A had the highest risk-adjusted strategic value (.452) followed by alternative D (.321). Alternatives B and E yielded risk-adjusted strategic values of .274 and .187, while alternative C yielded a negative risk-adjusted strategic value of –.316. Based on these calculations the most attractive alternative was A, followed by Alternative D.

MANAGERIAL SIGNIFICANCE

Global competition, advances in computer technology, and availability of data have made strategic decision making more complex and more critical than ever. Schoemaker and Russo [47] argue that as the significance and the complexity of a decision problem increases, so does the importance of the solution quality. While intuition and simple rules are still favorite decision-making methods, they may be dangerously inaccurate for complex decision problems. SAM is a MAU model that can help DMs improve their decision quality when they are confronted with complex problems like strategy selection. SAM helps DMs (1) ensure the consistency and completeness of the required information and (2) synthesize a vast amount of information into a manageable and easy to understand format. Similar models have been effectively applied to a wide range of complex strategic decisions [29] [47].

The analytical processes in SAM help a DM decompose the complex problem of strategy evaluation into manageable steps. SAM uses environmental scanning, AHP, entropy, and utility theory to help a DM crystallize thoughts and reduce inconsistencies at each step of the process. The strategic evaluation models that are similar to SAM tend to oversimplify the problem description. However, SAM manages the complex task of strategy evaluation without overly simplifying the problem description. In addition, the existing methods treat opportunity and threat factors as the broad environment of the organization. SAM treats these factors as problem-specific items and helps to manage them by grouping these factors into three categories. Finally, the attractiveness of any alternative depends upon the risk-taking capability of the DM. Therefore, the use of a utility function to integrate the DM's risk aversion factor into the rank ordering of the alternatives is expected to enhance the decision quality.

Although the technical details of SAM are complicated and potentially overwhelming for a DM, the concepts are not difficult. The analytical tools and techniques may require some technical assistance from the experts [47]. For example, using AHP to estimate the initial weights of the opportunities and threats requires very little training. The DM using software package such as Expert Choice can make pairwise comparisons on the screen while the complex mathematical manipulations are performed by the computer. In this case study, when SAM was implemented with appropriate user interface, the technical details became transparent to the DM. It also made "what-if" analysis a practical step in strategy selection.

CONCLUSION AND FUTURE RESEARCH DIRECTIONS

SAM decomposes a strategic problem into clearly defined components in which all alternatives, factors, weights, and probabilities are depicted. Next, objective information and subjective judgments of experts are integrated by utilizing several methods of problem structuring and information processing. This decomposition and evaluation is not intended to replace the DMs, rather, it provides a systematic approach to support, supplement, and ensure the internal consistency of their judgments through a series of logically sound techniques. Listed below are some obvious attractive features.

1. SAM stratifies the information requirements into a hierarchy that simplifies information input and helps focus DMs on a small area of the large problem. This process can also help by dividing the problem into different levels of detail for purposes of seeking input from different levels of managers in the organization.
2. Inconsistencies are inevitable while dealing with subjective information from different DMs. The built-in inconsistency checking mechanism of AHP helps in identifying inconsistencies in judgments at very early stages of the computation process.
3. Decision-relevant information about the strategic alternatives is transmitted through their environmental opportunities and threats. However, can the differences in the importance of opportunities and threats be captured fully by their weights or are they implicitly reflected in their probabilities of occurrence? SAM helps bridge the two concepts by enabling DMs to assess the relative weight of different opportunities and threats by the richness of their probability range. The more divergent the probability range of an opportunity or threat, the more information is emitted by it, and the more important it becomes in influencing strategic choice.
4. This approach can be utilized very easily on a PC because software packages for AHP such as Expert Choice are readily available and the use of SAM in an interactive format requires only some additional coding. We have implemented SAM but the current implementation does not have automatic interface with Expert Choice.
5. This model can be used in an interactive mode to deal with "what-if" situations, giving DMs a tool to evaluate alternatives in widely varied environmental scenarios.
6. There are no limits to the number of strategies and the number of factors that can be considered.

On the other hand, SAM only addresses some of the problems inherent in the strategic evaluation process. Quantification of all opportunities and threats is a difficult task. Storing information generated during a session for use in future sessions along with information on actual performance of the selected strategy can facilitate the process of learning from past mistakes. This may be done by interfacing SAM