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N-SITE: A DISTRIBUTED CONSENSUS BUILDING AND NEGOTIATION SUPPORT SYSTEM

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This paper presents N-Site, a distributed consensus building and negotiation support system, which is used to provide geographically dispersed teams with agile access to a Web-based group decision support system. Four teams located in France, Mexico, the Ukraine, and the United States participated in the N-Site project. Each team was required to research the problem using the World Wide Web (WWW). With this background, each team identified opportunities, threats and alternatives as a basis for developing a response to the Cuban Missile Crisis that confronted President Kennedy in October 1962. The strategic assessment model (SAM) (M. Tavana, *J. Multi-Criteria Decision Anal.* **11** (2002) 75–96; M. Tavana and S. Banerjee, *Decision Sci.* **26** (1995) 119–143.) was used by each team to choose a strategy that best fit the team's perspective. SAM and WWW enabled the teams to evaluate strategic alternatives and build consensus based on a series of intuitive and analytical methods including environmental scanning, the analytic hierarchy process (AHP) and subjective probabilities. The WWW was used to achieve interaction among the international teams as they attempted to negotiate a decision framework and select a diplomatic response. The project was assessed with a Web-distributed survey instrument. This use of the WWW has implications for international diplomacy as well as global business.

Keywords: Group decision support systems; multi-criteria decision making; World Wide Web; analytic hierarchy process; distributed consensus building.

1. Introduction

Strategic planning is vitally important and extremely difficult for any enterprise. One of the earliest and most enduring descriptions emphasizes its critical role and comprehensive nature in determining the fundamental goals of an enterprise along with the courses of action necessary for achieving those goals.[1,2] The difficulty of strategic planning is commensurate with its importance. The process is complex and ill-structured because it involves so many dimensions that solutions and simplifications in one dimension cause problems and complexity in others. Strategic decision making simultaneously involves a shortage of information on some of these dimensions and a surplus of information on others. Furthermore, the acquisition of additional information can reveal other courses of action or alter the importance

of goals and preferences for alternatives.[3] In all its aspects, strategic decision making requires the knowledge and expertise of the groups of decision makers (DMs) who are stakeholders in the enterprise. In a world characterized by rapid change, the process must be agile so that the stakeholders can access, process, and share information rapidly.[4,5]

The rapid evolution of information technology and tools for building decision support systems (DSS) since the early 1980s has produced an abundance of methods, models, and software to support groups confronted by complex, ill-structured problems like strategic decision making.[6–8] These group decision support systems (GDSS) are interactive computer-based systems that help DMs develop a common understanding of the issues, identify alternative solutions, explore what-if questions, identify conflicts and negotiate as they work toward compromise and consensus.[3] While GDSS have the potential to contribute to collaborative decision making, their use has been far below potential.[7] Huang[4] observed that it is crucial for "solution approaches to quickly support decision making and model analyzing." What is needed are approaches that allow DMs who are geographically separated to collaborate regardless of the computer platforms they are using.[9]

From a review of the negotiation literature, Lim and Benbasat[10] inferred one of the earliest arguments for exploiting the opportunities provided by modern information network technologies. They conceptualized the need for a negotiation support system consisting of individual DSS interconnected with an electronic communication channel. Subsequently, Bhargava *et al.*[7] recognized that decision making would become more agile and responsive if "users interact and exchange data with the technology over the World Wide Web (WWW), but do not have to obtain a copy of the software since execution occurs on the provider's platform." Contemporaneously, Karacapilidis and Papis[3] suggested that work on the implementation of GDSS pursue the integration of DSS, such as multi-criteria decision making techniques, with technical developments in electronic computing. They also proposed the use of the WWW to provide open, platform-independent access to GDSS.

It was Mustajoki and Hämäläinen[11] who first carried out the proposals of Karacapilidis and Papis.[3] They used a Java applet that provided an implementation of multi-variate value theory and the analytic hierarch process (AHP) to support the structuring, prioritizing and analysis phases of decision making. WWW-NIMBUS[12] was the first interactive multi-objective optimization system on the Internet. As suggested by Bhargava *et al.*,[7] its centralized computing and distributed interface overcame the problems of software delivery and update as well as limited computer capacity. Both Pooley and Wilcox[9] and Sikder and Gangopadhyay[13] employed these developments in the use of the Internet to overcome the impediments to collaborative decision making presented by spatial and temporal distances and to provide a sense of participation equality. In both these studies,[9,13] distributed cognition and discussion were promoted by the use of active maps to represent stakeholder positions.

The potential of the WWW as a means of distributed decision making is supported by research in the field of artificial immune systems.[14] Like the natural immune system, Web-based GDSS can function as powerful, parallel, and distributed adaptive systems providing rich and ample information as well as memory, retrieval, and learning capabilities. As with its biological counterpart, the overall behavior of a Web-based GDSS emerges from many local interactions. These properties contribute to the robustness of information processing in complex problems.[15] In today's global economy, business organizations are deploying Web-based GDSS to support distributed decision making among virtual teams in response to pernicious competition and endemic change.[16–18] Globally dispersed teams must interact to explore what-if scenarios, evaluate alternative strategies, and negotiate toward consensus.[19] For example, General Motors (GM) has linked its globally distributed manufacturing facilities with internal Web services that provide its production system engineering teams with access to best practices and analytical tools.[20] It seems likely that the future of GDSS will involve tools and technologies to support interorganizational GDSS and virtual teams.[21,22] These Web-based systems are powerful tools because they stimulate the shared identity and the shared cognition that are essential antecedents of negotiation success.[23–27]

This paper presents N-Site, a Web-based GDSS designed to support remote negotiation and consensus building[9,28] among groups of DMs separated by temporal or spatial distances. N-Site was implemented in a simulated international negotiation concerning the Cuban Missile Crisis and represents a merger of the GDSS and negotiation support system concepts in the open environment of the WWW. The N-Site participants were teams of MBA students at the ESCEM School of Management in France, the Universidad de las Americas in Mexico, the Lviv Institute of Management in the Ukraine, and La Salle University in the United States. The participants used the WWW to remotely access N-Site and utilize a set of models based on Saaty's AHP,[5,29–31] Tavana and Banerjee's SAM,[32,33] and Beck and Lin's maximum agreement heuristic (MAH).[34] The AHP and SAM enabled each team to formulate the problem and develop a ranking of the alternative courses of action while the MAH was used to produce a consensus ranking of the alternatives from the preferences of the teams.

N-Site provides advantages critical to resolving complex, ill-structured problems that require rapid responses from geographically dispersed teams. First, De Moor and Weigand[35] suggest that there is no general negotiation support system; rather, the need is for a set of domain-specific tools. N-Site assists DMs in structuring complex and ill-structured problems involving qualitative as well as quantitative criteria so that decision solutions can be developed and evaluated quickly.[32,33] Second, N-Site promotes distributed cognition and discussion by using active maps to represent stakeholders' positions.[9,13] Third, N-Site provides an interactive environment and easy access to others' models that support what-if analysis and negotiation.[19,36] Fourth, N-Site produces a consensus ranking of alternatives from the stakeholder teams' preferences.[32,34] Fifth, N-Site employs the

WWW to more fully utilize the potential of the GDSS by exploiting the information and knowledge of globally dispersed teams.[7,9,15] Sixth, N-Site functions as a powerful, parallel and distributed adaptive system providing rich and ample information.[14]

The N-Site project was evaluated with a Web-distributed survey questionnaire. The instrument was synthesized from the Information Systems Success model[37] and Davis's[38] approach to measuring the acceptance of information technology. The results indicate that N-Site had a significant positive impact on the teams' decision making satisfaction.

In Sec. 2, the essential components of N-Site are described. Section 3 presents the procedures followed by the participants in the N-Site project. Section 4 formulates the underlying algebraic model. The decision satisfaction assessment is presented in Sec. 5 with concluding comments in Sec. 6.

2. Framework and Architecture

The key components of N-Site are shown in Fig. 1. The framework integrates a database, a model base, Web resources, and intelligent resources with a Web-based user interface. Together, these components support data integrity, shared information space, and data communication.

Data about alternative solutions, decision criteria, subjective weights, and probabilities of occurrence, are obtained from user input and Web resources. Multicriteria decision making (MCDM) models such as the AHP, probability calibration,

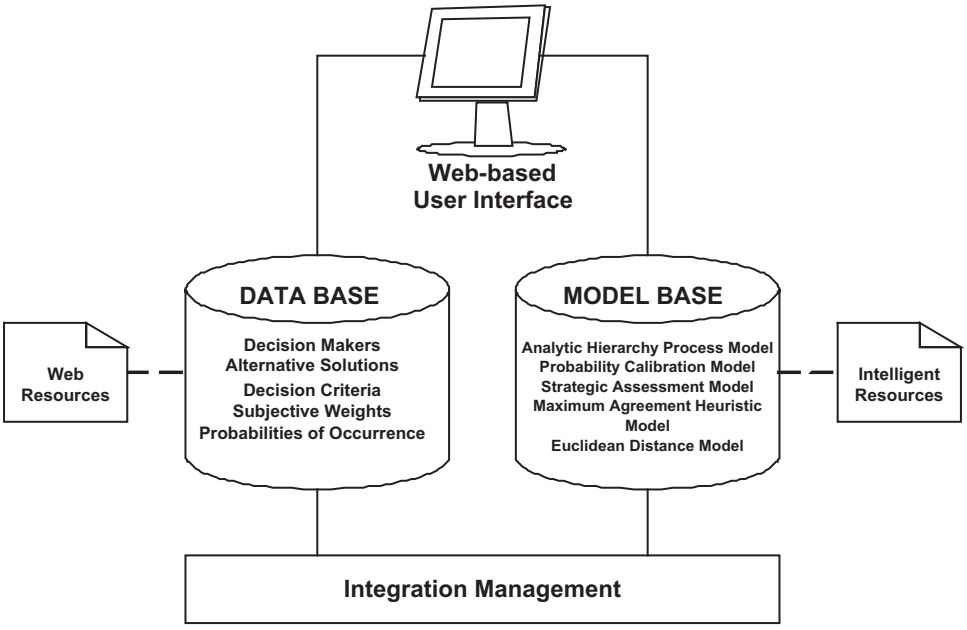

Fig. 1. N-Site framework and architecture.

the SAM and the MAH in the model base can be accessed and executed locally or remotely by DMs. Intelligent resources are used by the DMs to select and use methods appropriate for the problem. The database and model base are linked and managed with integration management. The system can facilitate communication among a group of DMs distributed in different locations through Web browsers. N-Site is supported by a Web server, database server, and clients. The Web server, running Microsoft IIS 4.0 (Internet Information Server) and ASP (Active Server Pages), manages all Web pages, traces user information and provides simultaneous services to multiple DMs. All the Web pages are created "on-the-fly" by the Web server which manages client tasks. The database server interacts with the Web server by using an ODBC (Open Database Connectivity) connection. The system interface is designed in JavaScript.

3. The Procedure

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. The SAM in N-Site decomposes the decision environment into (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 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. Each of these steps is described below while the details for calculating these factors are presented in the next section.

(1) Identify alternative courses of action: Initially, all the participants were asked to list what they thought were the viable alternative courses of action for the Kennedy administration. The database of N-Site was used to store this information. Participants were instructed not to post duplicate alternatives. Seven alternatives were identified by the participants:

1. Naval blockade
2. Air strike against Cuban targets
3. Invasion of Cuba
4. Negotiation/diplomacy
5. Dismantle all weapons
6. Air attack on the USSR
7. Reconnaissance missions.

Table 1. Results of yes–no vote on inclusion of strategic alternatives.

Alternative Courses of Action	Decision Maker																Number of Yes Votes
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Naval blockade	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	15
Air strike of Cuba	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	13
Invasion of Cuba	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	14
Negotiation/diplomacy	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	15
Dismantle all weapons	N	Y	N	N	N	Y	N	N	N	Y	N	Y	N	N	N	Y	5
Air attack on the USSR	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	Y	N	3
Reconnaissance missions	Y	N	N	N	Y	N	N	Y	N	N	N	Y	N	N	N	N	4

A description of each alternative is presented in Appendix A. To initiate the negotiation process, the participants used the database to post their votes on whether each alternative should be included in the analysis. They were instructed to respond simply yes or no. Table 1 shows that Naval blockade, Air strike against Cuban targets, Invasion of Cuba, and Negotiation/diplomacy received at least 2.5 times the number of yes votes than the other three alternatives. These four alternatives were chosen for inclusion in the analysis. Each team of DMs was instructed to input these four alternatives into the database in N-Site.

(2) Identify opportunities and threats within each environment: Each team of DMs identified and described a list of opportunities and threats within each environment as suggested by Tavana[32] and Tavana and Banerjee.[33] These opportunities and threats are actually the potential outcomes of alternative strategies in the internal, transactional, and contextual environments, not opportunities and threats in general. The teams of DMs posted 175 opportunities and threats within the three environments in the database:

27 Internal opportunities
29 Transactional opportunities
30 Contextual opportunities
25 Internal threats
30 Transactional threats
34 Contextual threats.

The negotiation process continued as the teams used a voting approach similar to the one used for the alternatives to select a manageable set of factors within each environment. The database in N-Site was used to store and retrieve the votes. As part of the negotiation process, teams were permitted to review the votes and reconsider their votes. As a consequence of these negotiations, the problem was formulated with four alternatives and 40 factors divided into six sets of internal, transactional, and contextual opportunities and threats. Each team of DMs was instructed to incorporate into the model base the factors presented in Table 2. Descriptions of these factors are provided in Appendix B.

Table 2. Environmental threats and opportunities.

	Internal Opportunities
IO1:	Possibility that the United States will have full control of the crisis because it can effectively withhold information from the media and public
IO2:	Possibility of Congress fully supporting President Kennedy
IO3:	Possibility of successful military missions
IO4:	Possibility that the United States will have an advantage because of its prior knowledge of the Cuban missile buildup
IO5:	Likelihood that Llewellyn Thompson's previous dealings with Khrushchev will result in a favorable outcome
IO6:	Possibility that the financial strength of the United States will result in a competitive advantage
	Transactional Opportunities
TO1:	Possibility that successful resolution of the crisis will result in Kennedy's re-election
TO2:	Possibility that the United States will be able to affect Cuba's economy
TO3:	Possibility that the United States nuclear missile superiority will threaten Russia and Cuba
TO4:	Possibility that US actions will have a direct effect on limiting Castro's power
TO5:	Likelihood that the United States will be able to obtain knowledge of Soviet technology
TO6:	Possibility that US intelligence will have an effect
TO7:	Possibility that US relations with other Latin American countries will improve
	Contextual Opportunities
CO1:	Possibility that the distance from Russia to Cuba will affect Russia's actions
CO2:	Possibility that Russia's weak economic position will have a favorable effect on US actions
CO3:	Likelihood of a coup attempt resulting in Castro's assassination
CO4:	Possibility that a hurricane or other type of weather disaster will affect US actions
CO5:	Possibility that the close proximity of Cuba to the United States will be an advantage
CO6:	Likelihood that a strained relationship between Khrushchev and other Latin American countries will result
	Internal Threats
IT1:	Possibility that President Kennedy will receive weak support from Congress
IT2:	Likelihood of a nationwide panic
IT3:	Possibility that US actions will fail
IT4:	Possibility that the media will make information public
IT5:	Likelihood that the United States will remove its missiles from Turkey
IT6:	Possibility of a security leak
IT7:	A large number of US military personnel are killed or wounded in action
	Transactional Threats
TT1:	Possibility that Russia will attempt to occupy Berlin
TT2:	Possibility that an unsuccessful resolution will adversely affect Kennedy's re-election
TT3:	Probability that US actions will be perceived as weak by Russia
TT4:	Likelihood that Russia or Cuba will threaten US military flights
TT5:	Likelihood that Russia will attack US military bases in Europe
TT6:	Possibility that Russia will not remove its weapons from Cuba
TT7:	Possibility that US actions will affect the Guantanamo Bay military base
	Contextual Threats
CT1:	Possibility that the United States will lose the support of its allies
CT2:	Likelihood that Cuba will retaliate on the United States with nuclear weapons
CT3:	Probability that tactical weapons will be used against US military forces
CT4:	Possibility that US actions will improve the relationship between Castro and Khrushchev
CT5:	Likelihood that Russia will continue its ammunition buildup

(3) Define environment-related weights: Next, each team was instructed to provide the subjective weights that represent the relative importance of the internal, transactional, and contextual environments for the problem. Such weights have been assigned directly by DMs using a scale from zero to one.[39,40] In N-Site, each team used the AHP model[41,42] to make its judgments and to perform the calculations required to define the environment-related weights. While the AHP is a widely used technique,[43] it could be replaced with other appropriate techniques.

To illustrate the AHP, suppose team i believes $c_1, c_2, \ldots, c_I$ are the I factors that contribute to the success of an alternative course of action. The AHP model in the model base asks the team to compare each possible pair of factors c_j, c_k and indicate which factor is more important and by how much.

These judgments are represented by an $I \times I$ matrix:

$$A = (a_{jk}) \qquad (j, k = 1, 2, \ldots, I)$$

If the team judges c_j to be equal in importance to c_k, then $a_{jk} = 1$
If the team judges c_j to be more important than c_k, then $a_{jk} > 1$
If the team judges c_j to be less important than c_k, then $a_{jk} < 1$

$$a_{jk} = 1/a_{kj} \qquad a_{jk} \neq 0$$

Thus, matrix A is a reciprocal matrix with the entry a_{jk} the inverse of the entry a_{kj}. a_{jk} reflects the importance of c_j compared with factor c_k. For example, $a_{12} = 1.25$ indicates that c_1 is 1.25 times as important as c_2.

The vector w representing the relative weights of each of the I factors is found by computing the normalized eigenvector corresponding to the maximum eigenvalue of matrix A. An eigenvalue of A is defined as λ, that satisfies the following matrix equation:

$$Aw = \lambda w$$

where λ is a constant, called the eigenvalue, associated with the given eigenvector w. Saaty[44] shows that the best estimate of w is the one associated with the maximum eigenvalue ($\lambda_{\max}$) of the matrix A. Because the sum of the weights should be equal to 1.00, the normalized eigenvector is used. Saaty's algorithm for obtaining this w is incorporated in the AHP model in N-Site.

One advantage of the AHP is that it assesses the consistency of the team's pairwise comparisons. When the judgments are perfectly consistent, the maximum eigenvalue ($\lambda_{\max}$) should equal the number of criteria that are compared (I). Typically, the responses are not perfectly consistent, and $\lambda_{\max}$ is greater than I. The larger the $\lambda_{\max}$, the greater is the degree of inconsistency. Saaty[29,42] defines a consistency index as $(\lambda_{\max} - I)/(I - 1)$ and provides a random index table for matrices of order 3–10. This random index is based on a simulation of a large number of randomly generated weights.

Saaty[29,42] recommends the calculation of a consistency ratio that is the ratio of consistency index to random index for the same order matrix. A consistency ratio

of 0.10 or less is considered acceptable. When the consistency ratio is unacceptable, the pairwise comparisons are logically inconsistent and should be revised. There has been some criticism of AHP in the operations research literature. Harker and Vargas[45] show that AHP does have an axiomatic foundation, the cardinal measurement of preferences is fully represented by the eigenvector method, and the principles of hierarchical composition and rank reversal are valid. On the other hand, Dyer[46] has questioned the theoretical basis underlying AHP and argues that it can lead to preference reversals based on the alternative set being analyzed. In response, Saaty[47] explains how rank reversal is a positive feature when new reference points are introduced. In N-Site, the geometric aggregation rule is used to avoid the controversies associated with rank reversal.[46–49] As in the preceding steps, the teams shared their perspectives with the other teams by storing the results in the database in N-Site. To further negotiation and consensus building, teams were also permitted to revise their probabilities after viewing those posted by the other teams. The weights resulting from this step were inputs to the SAM.

(4) Define weights associated with the opportunities and threats: Teams of DMs were instructed to provide the weights associated with each opportunity and threat. Again, the AHP model in the model base and the database were used to simplify the estimation process by confining the estimates to pairwise comparisons of factors within each environment. The measure of inconsistency provided by the AHP allows for the examination of inconsistent priorities. As before, the teams shared their views with the other teams by reporting them in the database. This continues the negotiation process and movement toward consensus.

(5) Develop subjective probabilities for each alternative: Next, each team was asked to estimate the probability of occurrence for each potential opportunity and threat. Such subjective assessments are often used in strategic management.[50] As suggested by many researchers,[51–54] probabilistic phrases like impossible, possible, and certain were used to elicit required information and then converted into numeric probabilities. Table 3 presents these verbal probabilistic expressions and their perceived probability estimates used in the model.[55] Alternatively, the DM may use numeric probabilities instead of the probabilistic phrases.

It was assumed that the subjective probability associated with a factor represents the probability of realizing the situation and is binomial. Binomial probabilities are commonly used in strategic decision making because the DM can simplify the problem by analyzing possible outcomes as either occurring or not occurring. For example, Schoemaker[56] assigns binomial probabilities to factors such as "Dow Jones Industrial Average falling below 1500 mark by 1990" or "Election of a Democrat as US president by 1990." Vickers[57] 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

Table 3. 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

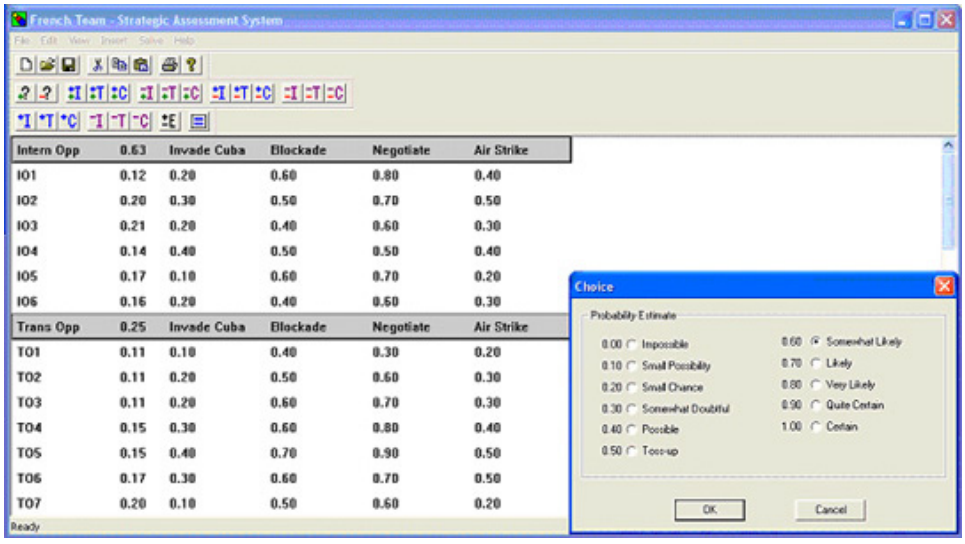

Fig. 2. Sample N-Site input screen.

primary motivation for using the binomial probabilities is to reduce the complexity of the model. Each team independently participated in several brainstorming sessions to develop these probabilities. To continue the negotiation and consensus building process, these were disseminated to the other teams through the database. Again, each team was permitted to revise its estimates after viewing this information. Figure 2 shows a sample input screen for probability assessment and data entry into the SAM.

(6) Calculate the strategic value per unit of risk for each alternative: Once all relevant data are stored in the database, the SAM in N-Site automatically

calculates the strategic value, the strategic risk and the strategic value per unit of risk for each alternative by using the algebraic model 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 product 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. The strategic 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.

The strategic value per unit of risk of an alternative is calculated by dividing the strategic value by its strategic risk. Higher strategic value increases the desirability, whereas higher risk decreases the desirability of that alternative. Assuming the DM is risk neutral, the alternative with the highest strategic value per unit of risk is chosen. If the DM is not risk neutral, a utility function may be developed to select the most desirable alternative. Strategic value per unit of risk, the reciprocal of the coefficient of variation, is also a commonly used measure for selection of alternatives in other areas, such as portfolio selection.[43,58] The weights, probabilities, and scores for each alternative determined in the model base are presented in a tabular form in Tables 4–7.

N-Site provides each team with the strategic value and strategic risk of each alternative along with the strategic value per unit of risk. The final rankings for each team were:

US team:	*Blockade* > *Negotiation* > *Air strike* > *Invasion*
French team:	*Negotiation* > *Blockade* > *Air strike* > *Invasion*
Ukrainian team:	*Negotiation* > *Blockade* > *Air strike* > *Invasion*
Mexican team:	*Blockade* > *Invasion* > *Air strike* > *Negotiation*

Table 4. Summarized comparisons between strategic alternatives for the US team.

			Invasion of Cuba	Naval Blockade	Negotiation Diplomacy	Air Strike of Cuban Targets
	$W^1_{u_i}$	$R^1_{u_{ij}}$	$P^{1m}_{u_{ij}}$			
Internal opportunities	0.55					
I01		0.09	0.2	0.4	0.7	0.2
I02		0.16	0.4	0.8	0.9	0.5
I03		0.14	0.6	0.8	0.6	0.6
I04		0.25	0.4	0.8	0.8	0.5
I05		0.22	0.2	0.8	0.9	0.2
I06		0.14	0.6	0.8	0.7	0.6

Table 4. (*Continued*)

			Invasion of Cuba	Naval Blockade	Negotiation Diplomacy	Air Strike of Cuban Targets
	$W^1_{u_i}$	$R^1_{u_{ij}}$	$P^{1m}_{u_{ij}}$			
Transactional opportunities	0.31					
T01		0.14	0.8	0.9	0.8	0.8
T02		0.11	0.9	0.7	0.2	0.3
T03		0.18	0.4	0.5	0.8	0.4
T04		0.08	0.9	0.4	0.2	0.5
T05		0.10	0.9	0.2	0.2	0.3
T06		0.25	0.9	0.6	0.8	0.9
T07		0.14	0.6	0.7	0.5	0.6
Contextual opportunities	0.14					
C01		0.21	0.7	0.9	0.5	0.8
C02		0.14	0.4	0.4	0.6	0.3
C03		0.09	0.4	0.4	0.1	0.2
C04		0.08	0.8	0.3	0.1	0.7
C05		0.32	1.0	1.0	0.2	1.0
C06		0.16	0.4	0.7	0.1	0.3
	$W^1_{t_i}$	$R^1_{t_{ij}}$	$P^{1m}_{t_{ij}}$			
Internal threats	0.07					
IT1		0.09	0.4	0.1	0.1	0.3
IT2		0.21	0.4	0.2	0.1	0.3
IT3		0.09	0.4	0.5	0.5	0.6
IT4		0.19	1.0	0.9	0.5	0.9
IT5		0.22	0.1	0.5	0.6	0.1
IT6		0.20	0.4	0.3	0.2	0.4
Transactional threats	0.23					
TT1		0.11	0.9	0.2	0.1	0.8
TT2		0.12	0.8	0.8	0.7	0.8
TT3		0.16	0.1	0.4	0.5	0.1
TT4		0.23	1.0	0.7	0.7	1.0
TT5		0.07	0.4	0.1	0.1	0.3
TT6		0.17	1.0	0.6	0.6	1.0
TT7		0.14	1.0	0.6	0.5	0.0
Contextual threats	0.70					
CT1		0.08	0.3	0.1	0.2	0.3
CT2		0.05	0.6	0.2	0.1	0.6
CT3		0.12	0.9	0.2	0.1	0.5
CT4		0.11	0.1	0.4	0.5	0.3
CT5		0.19	1.0	0.6	0.7	1.0
CT6		0.25	0.9	0.5	0.3	0.9
CT7		0.06	0.4	0.1	0.1	0.3
CT8		0.14	0.9	0.5	0.2	0.9
Total opportunity value (U^{1m})			0.55	0.71	0.65	0.52
Total threat value (T^{1m})			0.73	0.43	0.37	0.67
Strategic value (V^{1m})			−0.18	0.27	0.28	−0.15
Standard deviation (S^{1m})			0.41	0.27	0.34	0.40
Strategic value per unit of risk (E^{1m})			−0.44	1.00	0.83	−0.38

(7) Use the MAH to calculate the consensus ranking of the alternatives for all teams: Dyer and Forman[59] discuss several approaches to combining individual preferences into a joint representation of the group's preferences. First, the group members may try to reconcile differences of opinion by searching for consensus

Table 5. Summarized comparisons between strategic alternatives for the French team.

			Invasion of Cuba	Naval Blockade	Negotiation Diplomacy	Air Strike of Cuban Targets
	$W^1_{u_i}$	$R^2_{u_{ij}}$			$P^{1m}_{u_{ij}}$	
Internal opportunities	0.63					
I01		0.12	0.2	0.6	0.8	0.4
I02		0.20	0.3	0.5	0.7	0.5
I03		0.21	0.2	0.4	0.6	0.3
I04		0.14	0.4	0.5	0.5	0.4
I05		0.17	0.1	0.6	0.7	0.2
I06		0.16	0.2	0.4	0.6	0.3
Transactional opportunities	0.25					
T01		0.11	0.1	0.4	0.3	0.2
T02		0.11	0.2	0.5	0.6	0.3
T03		0.11	0.2	0.6	0.7	0.3
T04		0.15	0.3	0.6	0.8	0.4
T05		0.15	0.4	0.7	0.9	0.5
T06		0.17	0.3	0.6	0.7	0.5
T07		0.20	0.1	0.5	0.6	0.2
Contextual opportunities	0.12					
C01		0.25	0.2	0.4	0.5	0.3
C02		0.20	0.2	0.4	0.6	0.4
C03		0.19	0.3	0.7	0.8	0.4
C04		0.14	0.4	0.7	0.7	0.6
C05		0.11	0.2	0.4	0.6	0.3
C06		0.11	0.1	0.3	0.4	0.2
	$W^2_{t_i}$	$R^2_{t_{ij}}$			$P^{2m}_{t_{ij}}$	
Internal threats	0.30					
IT1		0.15	0.7	0.3	0.2	0.6
IT2		0.13	0.7	0.4	0.4	0.6
IT3		0.14	0.7	0.2	0.3	0.5
IT4		0.19	0.8	0.2	0.1	0.6
IT5		0.24	0.8	0.6	0.5	0.8
IT6		0.15	0.7	0.4	0.4	0.5
Transactional threats	0.16					
TT1		0.24	0.7	0.5	0.4	0.6
TT2		0.13	0.6	0.4	0.3	0.5
TT3		0.12	0.7	0.4	0.3	0.5
TT4		0.10	0.6	0.5	0.2	0.4
TT5		0.11	0.7	0.6	0.5	0.6
TT6		0.13	0.7	0.3	0.2	0.8
TT7		0.17	0.7	0.6	0.6	0.7

Table 5. (*Continued*)

			Invasion of Cuba	Naval Blockade	Negotiation Diplomacy	Air Strike of Cuban Targets
	$W^2_{t_i}$	$R^2_{t_{ij}}$	$P^{2m}_{t_{ij}}$			
Contextual threats	0.54					
CT1		0.16	0.8	0.4	0.4	0.8
CT2		0.18	0.8	0.2	0.1	0.7
CT3		0.14	0.7	0.3	0.3	0.6
CT4		0.14	0.8	0.5	0.4	0.7
CT5		0.10	0.7	0.4	0.2	0.6
CT6		0.13	0.6	0.3	0.1	0.5
CT7		0.10	0.5	0.3	0.2	0.6
CT8		0.05	0.8	0.3	0.3	0.7
Total opportunity value (U^{2m})			0.23	0.51	0.65	0.35
Total threat value (T^{2m})			0.72	0.37	0.29	0.64
Strategic value (V^{2m})			−0.49	0.14	0.36	−0.28
Standard deviation (S^{2m})			0.13	0.16	0.18	0.15
Strategic value per unit of risk (E^{2m})			−3.87	0.89	1.95	−1.90

Table 6. Summarized comparisons between strategic alternatives for the Ukrainian team.

			Invasion of Cuba	Naval Blockade	Negotiation Diplomacy	Air Strike of Cuban Targets
	$W^3_{u_i}$	$R^3_{u_{ij}}$	$P^{3m}_{u_{ij}}$			
Internal opportunities	0.53					
I01		0.15	0.3	0.8	0.3	0.5
I02		0.12	0.6	0.4	0.8	0.9
I03		0.26	0.4	0.3	0.5	0.7
I04		0.06	0.5	0.4	0.3	0.5
I05		0.30	0.4	0.6	0.9	0.1
I06		0.11	0.6	0.2	0.7	0.4
Transactional opportunities	0.21					
T01		0.19	0.2	0.2	0.4	0.5
T02		0.08	0.3	0.4	0.5	0.4
T03		0.14	0.4	0.3	0.9	0.4
T04		0.11	0.4	0.4	0.9	0.3
T05		0.15	0.2	0.4	0.7	0.4
T06		0.10	0.4	0.4	0.5	0.5
T07		0.23	0.2	0.3	0.4	0.6
Contextual opportunities	0.26					
C01		0.19	0.3	0.3	0.3	0.4
C02		0.15	0.4	0.2	0.5	0.6
C03		0.36	0.3	0.4	0.6	0.5
C04		0.08	0.6	0.7	0.4	0.7
C05		0.15	0.3	0.3	0.5	0.8
C06		0.07	0.4	0.2	0.6	0.4

Table 6. (*Continued*)

			Invasion of Cuba	Naval Blockade	Negotiation Diplomacy	Air Strike of Cuban Targets
	$W^3_{t_i}$	$R^3_{t_{ij}}$	$P^{3m}_{t_{ij}}$			
Internal threats	0.39					
IT1		0.17	0.3	0.2	0.3	0.4
IT2		0.10	0.5	0.2	0.5	0.5
IT3		0.17	0.6	0.3	0.4	0.4
IT4		0.16	0.6	0.5	0.5	0.4
IT5		0.19	0.4	0.2	0.3	0.5
IT6		0.21	0.8	0.1	0.3	0.6
Transactional threats	0.18					
TT1		0.18	0.8	0.3	0.2	0.7
TT2		0.16	0.7	0.2	0.4	0.4
TT3		0.14	0.5	0.3	0.5	0.7
TT4		0.07	0.4	0.4	0.3	0.3
TT5		0.18	0.5	0.2	0.3	0.4
TT6		0.14	0.3	0.4	0.3	0.9
TT7		0.13	0.8	0.7	0.4	0.5
Contextual threats	0.43					
CT1		0.20	0.7	0.3	0.5	0.6
CT2		0.15	0.6	0.1	0.4	0.5
CT3		0.25	0.9	0.4	0.2	0.4
CT4		0.08	0.8	0.4	0.2	0.5
CT5		0.06	0.4	0.7	0.1	0.4
CT6		0.08	0.8	0.6	0.2	0.8
CT7		0.05	0.4	0.4	0.3	0.4
CT8		0.13	0.5	0.2	0.7	0.5
Total opportunity value (U^{3m})			0.38	0.41	0.59	0.49
Total threat value (T^{3m})			0.62	0.30	0.36	0.51
Strategic value (V^{3m})			−0.24	0.10	0.23	−0.02
Standard deviation (S^{3m})			0.22	0.23	0.25	0.25
Strategic value per unit of risk (E^{3m})			−1.08	0.45	0.93	−0.06

Table 7. Summarized comparisons between strategic alternatives for the Mexican team.

			Invasion of Cuba	Naval Blockade	Negotiation Diplomacy	Air Strike of Cuban Targets
	$W^4_{u_i}$	$R^4_{u_{ij}}$	$P^{4m}_{u_{ij}}$			
Internal opportunities	0.45					
I01		0.14	0.4	0.3	0.5	0.1
I02		0.06	0.5	0.7	0.7	0.4
I03		0.20	0.7	0.6	0.5	0.8
I04		0.23	0.5	0.5	0.2	0.3
I05		0.13	0.4	0.7	0.3	0.6
I06		0.24	0.5	0.6	0.6	0.5

Table 7. (*Continued*)

			Invasion of Cuba	Naval Blockade	Negotiation Diplomacy	Air Strike of Cuban Targets
	$W^4_{u_i}$	$R^4_{u_{ij}}$	$P^{4m}_{u_{ij}}$			
Transactional opportunities	0.28					
T01		0.09	0.9	0.6	0.7	0.6
T02		0.15	0.8	0.7	0.4	0.1
T03		0.13	0.5	0.4	0.7	0.5
T04		0.03	0.7	0.3	0.1	0.7
T05		0.19	0.7	0.2	0.4	0.4
T06		0.19	0.6	0.7	0.9	0.7
T07		0.22	0.4	0.6	0.3	0.7
Contextual opportunities	0.27					
C01		0.32	0.9	0.8	0.2	0.5
C02		0.09	0.2	0.3	0.3	0.5
C03		0.13	0.5	0.3	0.3	0.4
C04		0.18	0.7	0.4	0.3	0.6
C05		0.16	0.8	0.7	0.4	0.8
C06		0.12	0.6	0.6	0.3	0.3
	$W^4_{t_i}$	$R^4_{t_{ij}}$	$P^{4m}_{t_{ij}}$			
Internal threats	0.16					
IT1		0.19	0.2	0.2	0.4	0.4
IT2		0.13	0.5	0.3	0.3	0.4
IT3		0.16	0.5	0.4	0.2	0.5
IT4		0.12	0.8	0.7	0.3	0.8
IT5		0.16	0.3	0.6	0.5	0.5
IT6		0.24	0.2	0.4	0.3	0.7
Transactional threats	0.29					
TT1		0.21	0.7	0.3	0.3	0.6
TT2		0.22	0.7	0.7	0.8	0.6
TT3		0.07	0.4	0.6	0.6	0.3
TT4		0.15	0.7	0.4	0.8	0.8
TT5		0.12	0.4	0.3	0.2	0.2
TT6		0.16	0.4	0.7	0.7	0.9
TT7		0.07	0.9	0.5	0.7	0.3
Contextual threats	0.55					
CT1		0.11	0.6	0.3	0.4	0.7
CT2		0.11	0.3	0.4	0.3	0.7
CT3		0.09	0.8	0.2	0.3	0.3
CT4		0.08	0.2	0.3	0.6	0.3
CT5		0.16	0.4	0.5	0.8	0.8
CT6		0.22	0.8	0.6	0.4	0.4
CT7		0.12	0.3	0.2	0.4	0.5
CT8		0.11	0.5	0.7	0.4	0.4
Total opportunity value (U^{4m})			0.59	0.55	0.42	0.50
Total threat value (T^{4m})			0.52	0.45	0.48	0.55
Strategic value (V^{4m})			0.07	0.10	−0.05	−0.05
Standard deviation (S^{4m})			0.27	0.24	0.28	0.28
Strategic value per unit of risk (E^{4m})			0.26	0.42	−0.19	−0.18

judgments. Second, they may subject intermediate judgments between extreme standpoints to a vote. Third, they may aggregate these decomposed judgments through normative averaging procedures. Finally, they may average the results of the individual models by assigning weights to the group members. All of these approaches suffer from some drawbacks. For example, normative aggregation procedures provide little stimulus for the exchange of opinions, and if the team's logic is not clear, the members of the group may have difficulty committing themselves to the synthesized outcome.[60,61]

The simulated international negotiation concerning the Cuban Missile Crisis is intended to promote consensus among teams. The term consensus is mathematically vague. If consensus means collective opinion, a weighted sum of alternative success factors across all the teams for a cardinal ranking of alternatives is appropriate. However, in negotiation the focus is finding the final ranking of the alternatives that is closest to the teams' preferences and also yields the greatest number of agreements. N-Site uses the MAH[34] because its definition of agreement meets these requirements. If a team ranks alternative m above alternative n and alternative m is also ranked above alternative n in the final consensus ranking, this counts as one agreement. In other words, if a team's ranking of alternatives m and n is the same as that in the final consensus ranking, the final ranking has yielded agreement, otherwise, it has yielded disagreement. Using the MAH, the consensus ranking of the four teams is: *Blockade* > *Negotiation* > *Air strike* > *Invasion*. These results and the feedback throughout the process could be used by policy makers to rethink their vision and strategic objectives.

4. Model Formulation

To formulate the algebraic model assume:

E^{fm} = Strategic value per unit of risk of the mth strategic alternative for the fth team; $(m = 1, 2, \ldots, q;\ f = 1, 2, \ldots, d)$

V^{fm} = Total weighted strategic value of the mth strategic alternative for the fth team; $(m = 1, 2, \ldots, q;\ f = 1, 2, \ldots, d)$

S^{fm} = Standard deviation associated with the mth strategic alternative derived from all opportunity and threat factors in all three environments for the fth team; $(m = 1, 2, \ldots, q;\ f = 1, 2, \ldots, d)$

U^{fm} = Total weighted opportunity value of the mth strategic alternative for the fth team; $(m = 1, 2, \ldots, q;\ f = 1, 2, \ldots, d)$

T^{fm} = Total weighted threat value of the mth strategic alternative for the fth team; $(m = 1, 2, \ldots, q;\ f = 1, 2, \ldots, d)$

V_u^{fm} = Variance of the value of the mth strategic alternative derived from all opportunity factors in all three environments for the fth team; $(m = 1, 2, \ldots, q;\ f = 1, 2, \ldots, d)$

V_t^{fm} = Variance of the value of the mth strategic alternative derived from all threat factors in all three environments for the fth team; ($m = 1, 2, \ldots, q$; $f = 1, 2, \ldots, d$)

$W_{u_i}^f$ = The ith environment opportunity associated weight of the fth team; ($i = 1, 2$, and 3; $f = 1, 2, \ldots, d$)

$W_{t_i}^f$ = The ith environment threat associated weight of the fth team; ($i = 1, 2$, and 3; $f = 1, 2, \ldots, d$)

$R_{u_{ij}}^f$ = The jth factor opportunity associated weight of the ith environment for the fth team; ($j = 1, 2, \ldots, N_{u_i}$; $i = 1, 2$, and 3; $f = 1, 2, \ldots, d$)

$R_{t_{ij}}^f$ = The jth factor threat associated weight of the ith environment for the fth team; ($j = 1, 2, \ldots, N_{t_i}$; $i = 1, 2$, and 3; $f = 1, 2, \ldots, d$)

$P_{u_{ij}}^{fm}$ = The mth opportunity associated probability of occurrence of the jth factor in the ith environment for the fth team; ($m = 1, 2, \ldots, q$; $j = 1, 2, \ldots, N_{u_i}$; $i = 1, 2$, and 3; $f = 1, 2, \ldots, d$)

$P_{t_{ij}}^{fm}$ = The mth threat associated probability of occurrence of the jth factor in the ith environment for the fth team; ($m = 1, 2, \ldots, q$; $j = 1, 2, \ldots, N_{t_i}$; $i = 1, 2$, and 3; $f = 1, 2, \ldots, d$)

N_u^f = Number of opportunity factors in the ith environment of the fth team; ($i = 1, 2$, and 3; $f = 1, 2, \ldots, d$)

N_t^f = Number of threat factors in the ith environment of the fth team; ($i = 1, 2$, and 3; $f = 1, 2, \ldots, d$)

Assuming that $i = 1$ through 3 represent the internal, transactional, and contextual environments, respectively, the most attractive strategic alternative is found by maximizing E^{fm}. The higher the E^{fm}, the more attractive the alternative. Alternatives with $E^{fm} \leq 0$ should be viewed unfavorably because 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, the objective is to maximize:

$$E^{fm} = \frac{V^{fm}}{S^{fm}} \tag{4.1}$$

where

$$V^{fm} = U^{fm} - T^{fm} \tag{4.2}$$

$$U^{fm} = \sum_{i=1}^{3} W_{u_i}^f \left(\sum_{j=1}^{N_{u_i}^f} R_{u_{ij}}^f P_{u_{ij}}^{fm} \right) \tag{4.3}$$

$$T^{fm} = \sum_{i=1}^{3} W_{t_i}^f \left(\sum_{j=1}^{N_{t_i}^f} R_{t_{ij}}^f P_{t_{ij}}^{fm} \right) \tag{4.4}$$

$$S^{fm} = \sqrt{V_u^{fm} + V_t^{fm}} \tag{4.5}$$

$$V_u^{fm} = \sum_{i=1}^{3} W_{u_i}^f \sum_{j=1}^{N_{u_i}^f} [(P_{u_{ij}}^{fm} - U^{fm})^2 R_{u_{ij}}^f] \tag{4.6}$$

$$V_t^{fm} = \sum_{i=1}^{3} W_{t_i}^f \sum_{j=1}^{N_{t_i}^f} [(P_{t_{ij}}^{fm} - T^{fm})^2 R_{t_{ij}}^f] \tag{4.7}$$

$$\sum_{i=1}^{3} W_{u_i}^f = 1 \tag{4.8}$$

$$\sum_{i=1}^{3} W_{t_i}^f = 1 \tag{4.9}$$

$$\sum_{j=1}^{N_{u_i}^f} R_{u_{ij}}^f = 1 \tag{4.10}$$

$$\sum_{j=1}^{N_{t_i}^f} R_{t_{ij}}^f = 1 \tag{4.11}$$

$$0 \leq P_{u_{ij}}^{fm} \leq 1 \tag{4.12}$$

$$0 \leq P_{t_{ij}}^{fm} \leq 1 \tag{4.13}$$

If each of the d teams has ranked q alternatives and their opinions are to be valued equally, the MAH seeks a consensus ranking of the alternatives for the group of teams as a whole. The MAH defines an agreement matrix A in which each element a_{mn} represents the number of teams who prefer alternative m to alternative n. Strict preference is important. If a team is indifferent between m and n, that team is not counted in a_{mn}. The sum of a_{mn} for each alternative m across all columns represents the positive preference vector, C, where

$$C_m = \sum_{n=1}^{q} a_{mn} \tag{4.14}$$

Similarly, the sum of a_{mn} for each alternative across all rows represents the negative preference vector, R, where

$$R_m = \sum_{n=1}^{q} a_{mn} \tag{4.15}$$

If for alternative m, $C_m = 0$, implying that no team prefers alternative m to any other alternative, m is placed at the bottom of the final consensus ranking and in subsequent iterations, at the next available position at the bottom. However, if for alternative m, $R_m = 0$, implying that no team prefers any other alternative over m, alternative m is placed at the top of the ranking and in subsequent iterations, at the next available position at the top.

When there are no zero values in either C or R, the MAH calculates the difference in total team agreement and disagreement $(C_m - R_m)$ for each alternative and considers alternative m with the largest absolute difference $|C_m - R_m|$. If $(C_m - R_m)$ is positive, the MAH places alternative m in the next available position at the top of the final consensus ranking, and if the difference is negative, it places alternative m in the next available position at the bottom of the consensus ranking. The MAH breaks ties arbitrarily. Once the MAH assigns an alternative a position in the final consensus ranking, it eliminates that alternative from further consideration. The remaining alternatives form a new matrix, and the MAH repeats the process until it has ranked all the alternatives.

5. Decision Satisfaction Assessment

The model used to evaluate N-Site is presented in Fig. 3. In this model, *Decision Making Satisfaction* is the dependent variable and is directly influenced by the following nine independent variables:

1. *Decision Quality.*[62–68]
2. *Decision Confidence.*[62,65,66,69,70]
3. *Consensus.*[64,66,67,71,72]

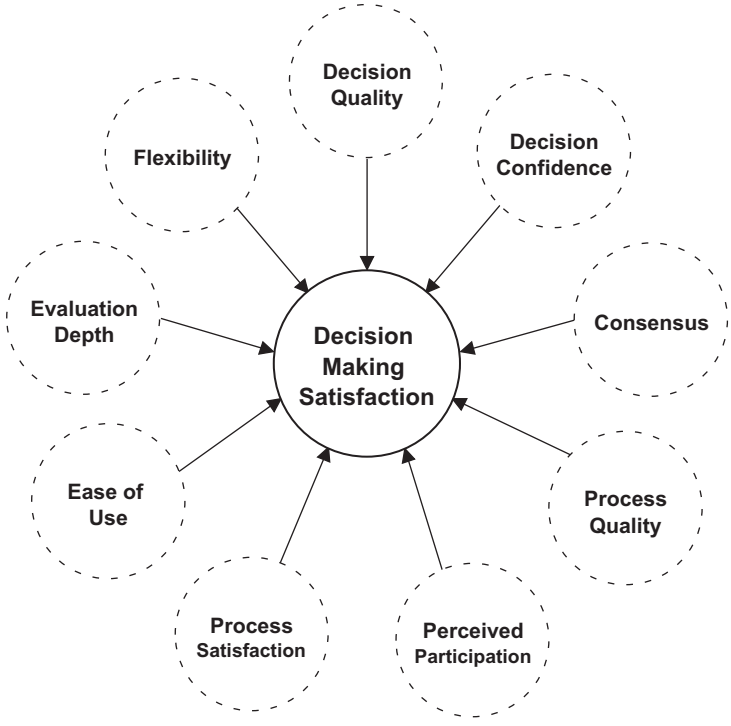

Fig. 3. The assessment model.

4. *Process Quality.*[37,63,74]
5. *Perceived Participation.*[74–76]
6. *Process Satisfaction.*[65,66,74]
7. *Ease of Use.*[38,62]
8. *Evaluation Depth.*[63,65–67,77]
9. *Flexibility.*[62,78]

A questionnaire with a seven-point scale was used to measure each independent variable. The seven points on the scale were: Strongly Disagree (−3), Quite Disagree (−2), Slightly Disagree (−1), Neither/Neutral (0), Slightly Agree (+1), Quite Agree (+2), and Strongly Agree (+3).

All four members of each of the four teams participated in the assessment. At the outset of the project, each participant was asked to provide a definition for each of the independent variables. Then, each team developed a consensus definition. Next, the groups used N-Site to synthesize a definition that was acceptable to all the teams. These definitions are:

1. *Decision Quality*: N-Site helped the teams reach the best possible decision.
2. *Decision Confidence*: N-Site increased commitment to the outcome.
3. *Consensus*: N-Site generated agreement among the teams essential to their cooperative action.
4. *Process Quality*: N-Site produced a comprehensive assessment of the decision.
5. *Perceived Participation*: N-Site contributed an unconstrained exchange of information and ideas.
6. *Process Satisfaction*: The N-Site process was logical, systematic, and expeditious.
7. *Ease of Use*: N-Site is easy to access and use.
8. *Evaluation Depth*: N-Site encouraged team members to articulate their views precisely and to reassess them with the feedback from the other teams.
9. *Flexibility*: N-Site was able to capture our team's view of the decision and our revisions as our team gathered information and considered feedback from the other teams.

The statistical results of the assessment are presented in Table 8. Consensus received the highest score while ease of use received the lowest score. The results of a two-sided t-test indicate that *Ease of Use* was the only independent variable that was not significantly different from zero at $\alpha = 0.01$. However, *Ease of Use* was significantly different from zero at $\alpha = 0.05$.

6. Conclusions

Global competition, conflict, and crises have made strategic decision making vitally important. However, the process is also extremely difficult because of the complexity of the problems, the lack of complete and timely information and the geographical dispersion of stakeholders. The process must be agile so that virtual teams can

Table 8. Statistical results.

Independent Variable	Mean	Standard Deviation	p-Value	Significant
Decision quality	2.75	0.45	0.0000	Y
Decision confidence	2.88	0.34	0.0000	Y
Consensus	2.94	0.25	0.0000	Y
Process quality	2.88	0.34	0.0000	Y
Perceived participation	2.69	0.48	0.0000	Y
Process satisfaction	2.75	0.45	0.0000	Y
Ease of use	0.63	1.02	0.0138	N*
Evaluation depth	2.25	0.58	0.0000	Y
Flexibility	2.63	0.50	0.0000	Y

Y, means are significantly different from Neutral at $\alpha = 0.01$; N, means are not significantly different from Neutral at $\alpha = 0.01$; N*, mean is not significantly different from Neutral at $\alpha = 0.01$ but it is significantly different at $\alpha = 0.05$.

share and process information rapidly. The Web-based GDSS N-Site assists virtual teams in overcoming these obstacles to interorganizational and transitional decision making by providing a framework for rapidly exchanging information among dispersed stakeholders and for accessing platform-independent DSS to manage that information.

This Web-based negotiation support system has positive implications not only for international diplomacy but also for companies with locations in different parts of the world. N-Site overcomes both spatial and temporal constraints. Stakeholders need not travel to participate in strategic decision-making sessions. Furthermore, their participation is less restricted by time constraints imposed by their absence from daily responsibilities. They would also have access to their own teams of experts and advisors. Consequently, they are likely to have more time to devote to negotiation and consensus building and are more likely to reach a quality solution.

A limitation of this study is that the N-Site participants were teams of MBA students. Because the participants were from this population, caution is essential in extending generalizations to other populations. In addition, the sample size and the use of N-Site within the context of an MBA course obscure the observation of cross-cultural differences such as those identified by Koeszegi *et al.*[79]

However, the benefits of N-Site appear to be reflected in the significant positive results in the decision satisfaction assessment. For all the independent variables describing the quality of a decision, the results indicate a significant positive impact on decision satisfaction. With these results, N-Site represents a prototype for negotiation support systems that would be invaluable in policy development for global organizations and global issues including responses to environmental crises and peace negotiations.

Acknowledgments

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Appendix A

Alternative courses of action

1. Naval blockade
A naval blockade is a viable alternative because the United States has sufficient ships with weapons and crews. The United States needs permission from the Organization of American States, because this is similar to policing international waters. A blockade will buy time to consider subsequent actions. It has a discovery stage and it can reveal the intentions of the Soviets.

2. Air strike against Cuban targets
An air strike against Cuba could eliminate offensive weapons from the island and the threat to the United States and other locations in the Western Hemisphere. This would be a hard line against Soviet aggression and would show them that the United States would be willing to go to war to protect American and NATO interests.

3. Invasion of Cuba
A ground invasion of Cuba could destroy missiles before they would be ready for activation. It would signal the Soviets that the missiles posed a serious threat to the United States. Also, it could be an opportunity to reclaim American influence on the island and return the Cuban exiles to their native country.

4. Negotiation/diplomacy
Through diplomacy, the arms and bases located in Turkey could be reduced or removed in exchange for removal of Soviet missiles from Cuba. The United States might be willing to negotiate a termination of the current lease it holds with Cuba for the base. Guantanamo Bay is the only US military base on communist land; through diplomacy the United States might be willing to negotiate for other concessions.

5. Dismantle all weapons
Dismantling would require a written document of how many weapons are currently held by each nation, and a timeframe for disposal, as well as a means for disposal. Such an action would involve outside monitoring by an organization such as the United Nations to ensure that each country carried out the plan as devised. Dismantling of the weapons from various bases and locations throughout the world can be a costly initiative for the United States.

6. Air attack on the USSR
An air attack of the Soviet Union could begin a nuclear war. However, Soviet missiles were only powerful enough to reach Europe while the US missiles were capable of striking the entire Soviet Union.

7. Reconnaissance missions
It is important to have intelligence about the construction, the types, and the location of the missiles being installed in Cuba. Photographs from the reconnaissance

missions can be used as proof of the Soviet missile installation and gain the support of the Organization of American States, United Nations, and other countries.

Appendix B

Environmental opportunities and threats negotiated through the database in N-Site

Internal opportunities

IO1: Possibility that the United States will have full control of the crisis because it can effectively withhold information from the media and public — because President Kennedy has a great amount of authority and because his advisors work hard to keep it that way, if the President wants something kept out of the press, it will stay out of the press.

IO2: Possibility of Congress fully supporting President Kennedy — Congress will most likely support President Kennedy's decisions because Congress will not want to be responsible for the outcome, or diminish the President's authority. As long as the President's actions are non-invasive, Congress will most likely approve of President Kennedy's actions.

IO3: Possibility of successful military missions — with the size of the US armed forces compared to other countries, any US military missions have a great possibility of succeeding.

IO4: Possibility that the United States will have an advantage because of its prior knowledge of the Cuban missile buildup — the United States will likely have an advantage over both Cuba and Russia because the United States discovered the existence of the missiles without Cuba or Russia realizing it. This will likely give the United States the opportunity to effectively plan strategies without Cuba or Russia anticipating the actions.

IO5: Likelihood that Llewellyn Thompson's previous dealings with Khrushchev will result in a favorable outcome — Llewellyn "Tommy" Thompson, the US ambassador to the Soviet Union, knows Khrushchev longer and better than any other Western diplomat. He believes Khrushchev intended for the missiles to be discovered as a bargaining chip.

IO6: Possibility that the financial strength of the United States will result in a competitive advantage — the US, financial strength will likely result in a competitive advantage against both Russia and Cuba. The United States has more capital and resources and can afford to outspend both Russia and Cuba.

Transactional opportunities

TO1: Possibility that successful resolution of the crisis will result in Kennedy's re-election — successful resolution of the crisis will enhance confidence and trust in President Kennedy, which will support his re-election.

TO2: Possibility that the United States will be able to affect Cuba's economy — there is a possibility that the United States will be able to affect Cuba's economy. Cuba has relied on the United States to purchase its exports and has relied on its monetary support.

TO3: Possibility that the US nuclear missile superiority will threaten Russia and Cuba — the 24 medium-range ballistic missile launchers (MRBMs) and 16 intermediate-range ballistic missile launchers (IRBMs) are the only nuclear missiles the Soviet Union controls that can reach the United States. However, the United States currently holds a 30 to 1 superiority in nuclear weapons most of which are stationed in Western Europe, Turkey and Polaris equipped submarines.

TO4: Possibility that US actions will have a direct effect on limiting Castro's power — the actions of the United States will likely have a direct effect on limiting Castro's power. The United States has in the past, implemented initiatives to remove Castro from power and to prevent the further spread of communism.

TO5: Likelihood that the United States will be able to obtain knowledge of Soviet technology — the United States will only be able to gain knowledge of Soviet technology in the event of a naval blockade where Soviet ships refuse to retreat and the United States is then forced to seize its cargo.

TO6: Possibility that US intelligence will have an effect — the United States has been able to collect substantial amounts of intelligence through three principal means: (1) human intelligence (HUMINT); (2) photographic intelligence (PHOTINT); and (3) signals intelligence (SIGINT).

TO7: Possibility that United States relations with other Latin American countries will improve — relations with other Latin American countries have the potential to improve because the people of Latin America will most likely have the view that the United States stood up to the Russians.

Contextual opportunities

CO1: Possibility that the distance from Russia to Cuba will affect Russia's actions — Cuba is 90 miles from the continental United States. Any invasion, bombing campaign or blockade can be easily supported from the United States. The proximity of Cuba to the United States put the entire contiguous United States with the exception of the Pacific Northwest in range the Soviet nuclear missiles base in Cuba.

CO2: Possibility that Russia's weak economic position will have a favorable effect on US actions — the Soviet economy is generally weak and has still not fully recovered from the Second World War. The expense of any protracted action so far from the Soviet Union would be costly.

CO3: Likelihood of a coup attempt resulting in Castro's assassination — in case of an invasion or air strike, the Cuban population may become disenchanted with Castro's leadership and Russian involvement, and a resulting uprising could lead to a coup attempt.

CO4: Possibility that a hurricane or other type of weather disaster will affect US actions — Cuba is a country with a tropical climate and in case of a hurricane or other storm, the United States will have to decide whether adverse weather condition will affect our plans and what the possible outcome will be.

CO5: Possibility that the close proximity of Cuba to the United States will be an advantage — the close proximity of Cuba to the United States, a distance of 90 miles, will give the United States and advantage whether the alternatives of invasion, naval blockade, or air strikes are carried out.

CO6: Likelihood that a strained relationship between Khrushchev and other Latin American countries will result — if the military mission succeeds, most Latin American countries will want a strong relationship with the United States.

Internal threats

IT1: Possibility that President Kennedy will receive weak support from Congress — although Congress has not always supported President Kennedy's policies in the past, the Cuban missile crisis is during the height of the Cold War and threatens the Continental United States.

IT2: Likelihood of a nationwide panic — the population of the United States will be concerned about the threat of war because of Cuba's close proximity to many US cities. Additionally, efforts to keep some information from the public may cause additional panic because the public will not feel they are being apprised of all the pertinent information.

IT3: Possibility that US actions will fail — failure is certainly a possibility because there is always a chance that Khrushchev will push the button and launch a nuclear war.

IT4: Possibility that the media will make information public — as stated above, because of the authority of the President, the possibility of the media going against Kennedy's wishes to make the information public is not likely.

IT4: Likelihood that the United States will remove its missiles from Turkey — the United States installed nuclear missiles in Turkey as a preventive measure in

case of military action by Russia. To resolve the crisis effectively, the United States may decide to remove its missiles from Turkey.

IT5: Possibility of a security leak — although President's Kennedy's staff will agree to keep information secret, there is the possibility that someone outside of his advising staff will leak information.

IT6: A large number of US military personnel are killed or wounded in action — any time that a country makes a decision for military action, the loss of life must be considered. The United States could lose a number of soldiers, but may be willing to do so in order to avoid possible future catastrophic losses.

Transactional threats

TT1: Possibility that Russia will attempt to occupy Berlin — Russia may attempt to take over Berlin in case of any military action by the United States in Cuba. A perceived threat by Russia may provoke military action in US occupied West Berlin.

TT2: Possibility that an unsuccessful resolution will adversely affect Kennedy's re-election — if US military mission is unsuccessful, the voters will likely blame Kennedy. This could lead to the election of a Republican president.

TT3: Probability that US actions will be perceived as weak by Russia — this perception can be attributed to President Kennedy's tolerance in allowing Khrushchev to build the Berlin Wall in an attempt to separate East and West Berlin. Kennedy's not acting may give Khrushchev the mistaken impression that he will not be challenged in anything that he does in the future.

TT4: Likelihood that Russia or Cuba will threaten US military flights — it is possible that Cuba will fire on routine US military flights if they believe that Cuba is in danger of an attack or simply to prevent the United States from continuing its routine surveillance of Cuban territory.

TT5: Likelihood that Russia will attack US military bases in Europe — the United States maintains a substantial military presence in Western Europe, the Mediterranean, and Turkey. Most of NATO's nuclear missiles and conventional land, air, and sea forces are situated to defend against a Russian attack.

TT6: Possibility that Russia will not remove its weapons from Cuba — the United States currently holds 30 to 1 superiority in nuclear weapons. The Russians may remove the nuclear weapons from Cuba if the US grants concessions.

TT7: Possibility that US actions will affect the Guantanamo Bay military base — US actions could likely affect the Guantanamo Bay military base in Cuba. It is perceived by Cubans as a symbol of US dominance and control.

Contextual threats

CT1: Possibility that the United States will lose the support of its allies — if other countries believe that the United States is threatening a much smaller country such as Cuba, or does not attempt to at least negotiate with Russia, other countries will not want to support US actions in the future.

CT2: Likelihood that Cuba will retaliate on the United States with nuclear weapons — this is an unlikely situation because Cuba alone does not have the resources to retaliate on us. They have to depend on the Soviets for power.

CT3: Probability that tactical weapons will be used against US military forces — while it is unlikely that the Russian controlled nuclear weapons will be used. Conventional tactical weapons may be employed against US spy and Military flights and US Navy ships.

CT4: Possibility that US actions will improve the relationship between Castro and Khrushchev — in case of any type of action against Cuba or Russia, Khrushchev may opt to further support Castro by providing additional weapons to Cuba to be used against the United States.

CT5: Likelihood that Russia will continue its ammunition buildup — it is highly unlikely that Russia will be able to continue its ammunition buildup because the United States has now discovered their existence. Russia realizes that it would be unwise for them to continue supplying

CT6: Probability that Russia will attempt to blockade West Berlin — in the event that the United States acts against Cuba, Russia may retaliate by attempting to blockade West Berlin. West Berlin is occupied by US troops and a Soviet blockade could effectively cut off necessary foods and medical supplies.

CT7: Possibility that Cubans will take control of the nuclear weapons — however, the Cubans do not have the armed forces or military intelligence to take over the Soviets.

CT8: Possibility that Russia will use submarines — the Soviet Union submarine fleet routinely patrols the Caribbean and makes regular port calls in Cuba. The Russians may use Subs to run a US blockade, attack a blockade, or thwart any US military action.

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