NINA'S DECISION: HOW TO MAKE BETTER DECISIONS AND RESOLVE CONFLICTS

AN ESSAY FOR THE LAYMAN

Thomas L. Saaty
Distinguished University Professor
University of Pittsburgh
saaty@katz.pitt.edu

H.J. Zoffer
Dean Emeritus and
Professor of Business Administration
University of Pittsburgh
zoffer@katz.pitt.edu

Decision making is a central activity of all people, usually done so automatically that we do not even realize that we are doing it every moment of every day of every year for all our lives. This silent and inarticulate approach worked well when humanity was fragmented and individuals and groups of people didn't have to think of others very much. Today however, the world has become expanded and interdependent and many of its resources are becoming scarce and valuable, including water, land, air, vegetation and minerals. Now we have to consciously work together to choose important courses of action, and we have to justify these actions not only to ourselves but also to others, so we can live in harmony and with minimum conflict.

Nearly all of us have been brought up to believe that clear-headed logical thinking is our only sure way to face and solve problems. But experience suggests that logical thinking is not natural to us. Indeed, we have to practice, and for a long time, before we can do it well. Since complex problems usually have many related factors, traditional logical thinking leads to sequences of ideas so tangled that often the best solution cannot be easily discerned.

Our present complex environment calls for a new logic ─ a new way to cope with the myriad of factors that affect the achievement of goals and the consistency of the judgments we use to draw valid conclusions. This approach should be justifiable and appeal to our wisdom and good sense. It should not be so complex that only the educated can use it, but should serve as a unifying tool for thought in general.

The lack of a coherent procedure to make decisions is especially troublesome when neither logic nor intuition are helpful in determining which of several options is the most desirable, or the least objectionable. Since we are concerned with real-life problems, we must recognize the necessity for tradeoffs to best serve the common interest. To be really useful,

this process should also assist in building consensus and reaching a compromise. We need a way to determine which objective outweighs another, both in the near and long terms.

How can we do this? We describe and discuss a logical approach, the Analytic Hierarchy Process (AHP), that can be used to make such decisions. It involves breaking a problem down into finer and finer parts, so that one is called upon to give a judgment comparing only a pair of issues in each judgment. This avoids mixing too many aspects of a problem, and not knowing what goes with what to obtain the final answer. However, it does call for one to structure the problem hierarchically with broad understanding of the people and their interests and of the issues involved. Once one has the structure, it becomes easier to convey to others the influences driving a decision. All possible factors should be included in the structure; all sides involved in the discussion should be able to include whatever factors they feel appropriate, no matter how critical or unfriendly they may be. Later, a process of prioritization by the different stakeholders will weed out the unimportant or irrelevant factors. In cases of extreme disagreement, the arguments of outliers can be given appropriate weightings and then combined with the positions of the majority.

The AHP has appealed to managers and decision-makers at all levels of decision-making. It enables one to include both the strength of feelings needed to express judgments, and the logic and understanding relating to the issues involved in the decision. It combines the multiplicity of judgments in a systematic way to obtain the best outcome, or mix of actions to be taken. Finally, and more significantly, these outcomes are derived in an agreeable way that are in harmony with our intuition and understanding and not forced on us by technical manipulations. We should be able to say that, given the information, we agree on the method of making the decision (if not the outcome of any particular decision). The matter becomes a common concern, not a mystical phenomenon.

In summary, the process contributes to solving complex problems by structuring a hierarchy of criteria, stakeholders, and outcomes and by eliciting judgments to develop priorities. It also leads to prediction of likely outcomes according to these judgments. The outcome can be used to rank alternatives, allocate resources, conduct benefit/cost comparisons, exercise control in the system by evaluating the sensitivity of the outcome to changes in judgment, and carry out planning of projected and desired futures. A useful by-product of the process is a measurement of how well the people involved understand the relationships among the factors. Although people generally are not consistent, the main concern here is the degree of their inconsistency. Is their understanding close to capturing the interactions observed, or is it a random understanding that only hits the target now and then?

Good decisions must survive the difficulties and hazards of people and environment. We need to make decisions that are both desirable and survivable, rather than simply ones that we like best, without regard to how lasting they may be. Predicting outcomes plays an important role in making such choices. To do this well, we can decompose a decision into separate structures involving scenarios of benefits, costs, opportunities and risks and then carefully combine their separate outcomes for the best decision.

Decision-making groups need to formalize their agenda and structure their interactions. Group decision making needs a process that can unfold the complexity of the issues or problems. Recognizing that perceptions and stakes can vary among group members, such a process should also specify how individuals can bargain on specific differences. Finally, it would be desirable to have a measure of the consistency of judgments which individuals give and which the group settles on. The Analytic Hierarchy Process described in this paper is such a process.

One might ask: Why is it that so many distinguished politicians and negotiators have so often failed to reach consensus on conflict after decades of trying? Here are some possible reasons:

1. They had no way to measure the importance and value of intangible factors which can dominate the process.

2. They had no overall unifying structure to organize and prioritize issues and concessions.

3. They had no mechanism to trade off concessions by measuring their worth.

4. They had no way to capture each party's perception of the other side's benefits and costs.

5. They had no way to provide assurance to the other party that they, the opposing party, were not gaining more.

6. They had no way to avoid the effect of intense emotions and innuendoes which negatively affect the negotiation process.

7. They had no way to test the sensitivity and stability of the solution to changes in their judgments with respect to the importance of the factors that determined the best outcome.

In the Analytical Hierarchy Process, we address all these factors in an integrated framework. Its main purpose is not only to include the measurement of tangible factors, but also to measure the myriad of intangibles which can seriously affect the ultimate outcome. The word intangible is most commonly used to describe things that are recognized but not easily quantified or measured. Our purpose is to show that all intangibles can be measured in relative terms by using comparisons. A trivial example is that of choosing the best candidate for a husband.

- Nina is an attractive 27 year old MBA graduate with three years of business experience. She is from a middle class family and wants to choose a husband from among three suitors. Her criteria are age, looks, intelligence and economic status. These are her suitors.

- Peter is a rugged looking 30 year old engineer with a well-paying job, interested in his career and in raising a family. He is a hard-nosed, no nonsense kind of person, gentle and loving;
- David is a 37 year old promising artist who is very romantic but whose career is still developing. His income from day to day is uncertain, but he is a sensitive, imaginative genius with a lot of promise. He is more interested in beauty and spirit than he is in accumulating wealth;
- George is a 25 year old handsome, virile and fast moving young man with a brilliant future in a famous and successful family business. He is extremely generous and thoughtful, but he is also temperamental and assertive.

Figure 1 represents the structure of the problem. At the top is the goal (Choosing the Best Husband for Nina). At the second level of the hierarchy, below the goal are the criteria that Nina has chosen to judge the possible husbands, and at third level of the hierarchy are the candidate husbands, the alternatives of the decision making process. The numbers in each cell represent the priority or importance of the criteria in Table 1, and of the weighted priorities of the alternatives in Table 3.
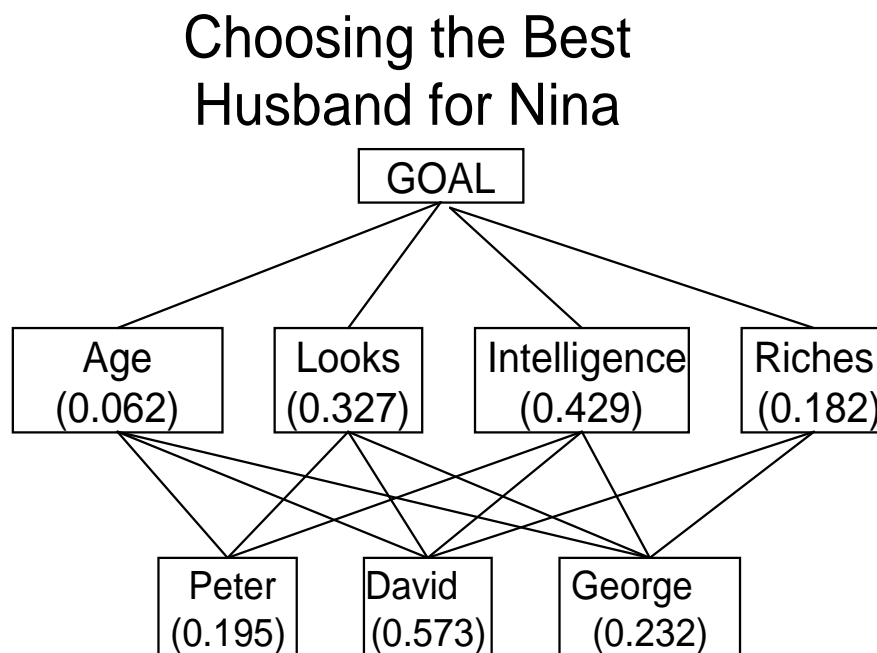
Choosing the Best Husband for Nina

Figure 1 Best Husband Hierarchy

Nina has to determine the priorities of the four criteria and then judge the three suitors by comparing them on each criterion separately. Finally, she must weight or multiply the priorities of the candidates by the importance or priorities of the criteria and add to determine the best candidate. We call these judgments a system of comparisons or better

pairwise comparisons. In this decision process, Nina is busily occupied making the judgments, and is unaffected by the overall impression that each individual candidate might have on her. This is because she is forced to determine priorities by comparing them and then rank the candidates on the basis of these comparisons. Thus, the process drains away the bias that her emotions might otherwise cause.

The pairwise comparison judgments of the criteria given by Nina in this case are shown in Table 1. The judgments are entered by comparing a criterion listed on the left of the table with another listed at the top. A criterion compared with itself is always assigned the value of one. The numbers 3, 5, 7, and 9 correspond to the verbal judgments of the comparisons of elements on the left over those at the top: "moderately more dominant", "strongly more dominant", "very strongly more dominant", and "extremely more dominant" (with 2, 4, 6, and 8 for compromise between the previous values). Reciprocal values (1/3, 1/5,1/7, 1/9) are automatically entered when the element on the left does not dominate but is dominated by the element at the top of the table. She must make a total of $(4 \times 3)/2 = 6$ pairwise judgments. There are 16 positions in all with four "ones" for comparing the elements with themselves and half of the remaining 12 are the reciprocals of the others, so six judgments need to be entered.

The priorities are obtained by raising the matrix to a large power to capture all the interactions, adding the entries in each row and dividing by the total sum of the rows. We are permitted to use decimal values between the integers, such as 2.6, if desired. It has been mathematically demonstrated that it is necessary to use this scale to get meaningful results in practice. It represents the normal range of human sensitivity to phenomena that are homogeneous. When things are widely scattered, they can be grouped into separate clusters with a common element in adjacent clusters, and the scale 1 to 9 is applied to compare the elements in each cluster with the common element serving as a link. When there are actual measurements for pairs being compared, such as money, we can use the ratio of their measurements.

It is generally preferable to use the verbal judgment. With some software packages there are several equivalent modes: verbal, matrix mode in which numbers are entered in a matrix, the graphical model allowing graphical comparison of a pair, and the direct mode in which raw data can be entered for all elements in the comparison (not a pairwise comparison mode). Judgments entered in any mode are reflected in the others. In Table 1, when comparing Age on the left with Looks on top, she thinks that Looks are very strongly more important, and the value 1/7 is entered in the (Age, Looks) position, and a 7 is automatically entered in the (Looks, Age) position. Similarly, in comparing Intelligence with Looks, she thinks that Intelligence is slightly more important than Looks, and a 2 is entered in the (Intelligence, Looks) position, and a 1/2 is entered in the (Looks, Intelligence) position and so on. We always compare the criterion on the left as to how much more dominant it is than the criterion at the top. If it is not, the reciprocal value is used. In Table 2 Nina compares the candidates as to who is better and the strength of their superiority for each criterion. She does this first with respect to age, then looks, then intelligence and finally riches.

Table 1
Comparing the criteria for importance with respect to the goal

	Age	Looks	Intelligence	Riches	Priorities
Age	1	1/7	1/5	1/3	.062
Looks	7	1	1/2	2	.327
Intelligence	5	2	1	2	.429
Riches	3	1/2	1/2	1	.182

Table 2
Comparing the suitors with respect to the criteria

Age	Peter	David	George	Priorities
Peter	1	3	1/3	.258
David	1/3	1	5	.105
George	3	1/5	1	.637

Looks	Peter	David	George	Priorities
Peter	1	1/5	2	.166
David	5	1	7	.740
George	1/2	1/7	1	.094

Intelligence	Peter	David	George	Priorities
Peter	1	1/5	3	.188
David	5	1	7	.731
George	1/3	1/7	1	.081

Riches	Peter	David	George	Priorities
Peter	1	5	1/4	.237
David	1/5	1	1/8	.064
George	4	8	1	.699

In Table 3 we multiply the weights of the suitors by the weights of the criteria and add to obtain the final ranking.

Table 3
Synthesis of the priorities

Criteria / Suitors	Age (0.062)	Looks (0.327)	Intelligence (0.429)	Riches (0.182)	Priority Synthesis
Peter	.258	.166	.188	.237	.195
David	.105	.740	.731	.064	**.573**
George	.637	.094	.081	.699	.232

David wins because he has better looks and is more intelligent. Both criteria have high priorities of 0.327 and 0.429 or a total of 0.756 of the assessment. Thus, she should marry David the artist. This approach to prioritization provides the opportunity to help focus attention on the important issues and allocate resources to them accordingly.

Other applications and accomplishments of AHP include:

- Since its early development the AHP has been used to correctly predict, a few months before the election, the next candidate to be elected for president. The factors involved varied from election to election, depending on the domestic and international circumstances prevailing at the time.

- In 1986, the Institute of Strategic Studies in Pretoria, a government-backed organization, used the AHP to analyze the conflict in South Africa and recommended actions ranging from the release of Nelson Mandela to the removal of apartheid and the granting of full citizenship and equal rights to the black majority. All of these recommended actions were quickly implemented by the white government.

- A company used the AHP in 1987 to choose the best type of platform to build to drill for oil in the North Atlantic. A platform costs around 3 billion dollars to build, but the demolition cost was an even more significant factor in the decision.

- Xerox Corporation has used the AHP to allocate close to a billion dollars to its research projects.

- IBM used the process in 1991 in designing its successful mid-range AS 400 computer. IBM won the prestigious Malcolm Baldrige Award for Excellence for that effort. The book about the AS 400 project has a chapter devoted to how AHP was used in benchmarking.

- The AHP has been used since 1992 in student admissions, and prior to that in military personnel promotions, and hiring decisions.

- In 1995, the process was applied to the U.S. versus China conflict in the intellectual property rights battle over Chinese individuals copying music, video, and software tapes and CD's. An AHP analysis involving three hierarchies for benefits, costs, and risks showed that it was much better for the U.S. not to sanction China. Shortly after the study was complete, the U.S. awarded China most-favored nation trading status, and did not sanction it.

- In sports the AHP was used to predict which football team would go to the Superbowl and win in 1995 (correct outcome, Dallas won over our hometown, Pittsburgh). The AHP was applied in baseball to analyze which Padres players should be retained.

- British Airways used the process in 1998 to choose the entertainment system vendor for its entire fleet of airplanes

- The Ford Motor Company used the AHP in 1999 to establish priorities for criteria that improve customer satisfaction.

- In 2001 it was used to determine the best site to relocate the earthquake devastated Turkish city of Adapazari.

- A comprehensive analysis as to whether the Unites States should develop an anti-nuclear missile (estimated in the 1990's to cost $60 billion and strongly opposed by scientists as technically infeasible) was presented to the National Defense University (NDU) in February 2002. In December of that year President Bush decided to move forward, andthe US actually developed prototypes and successfully tested them in stages.

- An application by Professor Wiktor Adamus of Krakow University convinced the prime minister of Poland in 2007 not to adopt the Euro for currency until many years later.

- An AHP application, known to the military at the Pentagon, showed that occupying or bombing Iran is not the best option for security in the Middle East in terms of benefits, opportunities, costs and risks.

- The AHP was used to assist the Green Bay Packers in hiring the best players, perhaps partly the reason why they won the Superbowl in 2011 by beating the Pittsburgh Steelers. Other sports, including hockey and baseball teams, are also using it.

- AHP was used in three studies by economists to determine the turn-around dates of the US economy and the strength of recovery, in 1991, 2001 and 2009. These studies were uncannily accurate.

- The AHP is used by many organizations, including the military, to prioritize their projects and allocate their resources optimally according to these priorities.

- The latest application of the AHP, made in August 2011, was to the Israeli-Palestinian conflict. Five top participants from each side used the process to reach an agreement called the Pittsburgh Principles. One of them wrote: "I had been in hundreds of meetings between Israelis and Palestinians where we tried to reach a joint statement but failed because in most of the cases each side was trying to score points and court his own public opinion rather than being objective and trying to be real and responsible".

Where there are people with different objectives that cannot coexist, there is potential for conflict; if individuals or groups attempt to satisfy only their own objectives conflict will

occur. Applications of the AHP in conflict resolution have been applied to a variety of conflicts. Two of these conflicts, South Africa and Northern Ireland, have been significant, and the AHP had an effect on their outcome.

Most discussions on conflict start with the premise that there will always be winners and losers in any situation where people have opposing desires. Sometimes this is true; however, it is often possible to find a compromise that will work especially in the short run. In the long run, of course, it is usually necessary to remove the underlying source of the conflict, if that is possible.

Conflict resolution has frequently been defined as the search for an outcome that, at a minimum, represents for some participants an improvement from, and for no participants a worsening of, their present situation. If such outcomes exist, we want to find them, and then need see which of these outcomes is in some sense "best." To the Olympian observer, this is obviously the way to go. However, in any conflict the participants will have conflicting objectives and desires, and the so-called best outcome will almost certainly fall short of each party's desired outcome.. How can we persuade each party to cease pursuing its own goals and to accept the compromise solution? The most distinctive attribute of humans is their ability to reason and analyze. It is particularly necessary that people in conflict should use reason, since there may be many interests at stake. To hold one's ground without the use of reason is to inhibit progress. We need to introduce more reason and less intransigence into our methods of conflict management.

In summary, AHP has been used all over the world in a variety of problem settings that would have otherwise been difficult to analyze. It is only now being applied to certain situations, such as the Israeli-Palestinian conflict, because of the complexity of that set of issues and the fact that it is an extremely retributive conflict (each side wants to inflict pain on the other side), and therefore lacks the advantage of most negotiations where both sides want the best solution without regard to inflicting any kind of pain on the other side. While a description of the process as noted above explains the technicalities of the initiative, only personal participation in an AHP exercise will highlight the advantage of this approach.