Making Better Decision Makers

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Decision analysis has been used to help solve numerous complex decisions over the last few decades. However, its power as a basis for structuring one's thinking to resolve decisions has barely been tapped. To realize this potential, we in the decision analysis community must train people to think about their decisions using the concepts and principles of decision analysis. In this process, more emphasis must be placed on structuring decisions worth thinking about, and less emphasis must be placed on analyzing structured decisions. This paper outlines what we should do to train people to be better decision makers and why this is important. It includes a description of what we must learn to do this effectively.

1. Introduction

The field of decision analysis is concerned with helping people make better decisions. Most teaching and application of decision analysis focuses on structuring and analyzing models of specific decision problems. In the classroom, decision problems are typically well defined and structured for solution. The procedures and analytical techniques necessary to analyze the decisions are learned. In practice, consultants work on particularly messy, unstructured, complex decisions that require an expert at solving decisions. Participants learn something about structuring decisions, but they typically cannot follow the analysis. Both teaching and consulting with individuals helps train them to make better decisions, but it falls short of what we could accomplish.

Consider whether those with some training in decision analysis use it. There is of course, always the question of what it means to "use it," but I adopt the definition that one's conscious use of the concepts and insights learned means *use*. Over the past few decades, there have been hundreds of thousands of people in graduate business programs and other graduate programs who have taken a course in decision analysis or managerial decision making. Some of those people use some of the concepts and insights on some of their decisions. Very few of those individuals have done a formal analysis of an important

problem that they faced after they began or resumed their careers. By and large, the body of what we teach to facilitate making complex decisions has neither become a way of thinking about decisions nor had anywhere near the positive effect it should have.

The purpose of this paper is to suggest how we—those of us who teach and/or apply decision analysis—could better train people to be good decision makers. I stress what it is we should do and why it is important. The high level of how it could be done is discussed, but the details are left for individual teachers and decision analysts as they see fit.

My two audiences are decision analysts, who would do the training, and individuals who could greatly benefit from the knowledge of the potential of such training, such as corporate and government executives and managers of training departments.

This paper is organized as follows. The next section outlines the situation that many decision makers are in today. Section 3 discusses the manner in which they typically make decisions. Section 4 suggests how they could better make their decisions if they were trained well in decision making. In §5, we indicate why the foundations of decision analysis are a sound basis to guide the training to develop a sound decision maker. Section 6 discusses what decision analysis has always offered to make better decisions. Section 7 suggests how this can be broadened to also make better

decision makers. To do this, §8 discusses practical implications about what we need to learn and what we need to do to train others to be better decision makers. Section 9 is a summary.

2. Decision Makers Today

We are all decision makers. Many times a day we face decisions and make choices. Only a few of these are singularly important, but numerous small decisions collectively have significant consequences that matter. If you regularly make mediocre decisions, you may never accomplish the things that are important to you, your family, or your career.

We all learn decision making by doing it. This is partly because we start very young and there are not training programs for two-year-old decision makers. Indeed, very few people have ever had any training in decision making. Contrast this to skills other than decision making that we tend to learn when we are older than two and our minds are better developed. To learn skills, such as playing sports, playing musical instruments, practicing different art forms (e.g., painting), and using computers, we break them into small parts, which I will refer to as elements that are necessary to do well and become skillful. We then learn how to master each of the much simpler elements by study and practice. Once we have learned the different elements individually, we practice them in pairs and eventually all together. The intent is that the knowledge developed in practice can be integrated to become skillful.

To be more concrete, consider tennis. Some of the elements are the serve, the forehand, the backhand, the lob, and the drop shot. Each of these can be broken into component elements. With the serve, there are feet and body positioning, the ball toss, and hitting the ball. One can learn how to carry out each element or a component of an element individually and practice what was learned to improve. Then, we put the elements together and hopefully play a better tennis game than we otherwise would. Consider the number of tennis players who have had lessons to develop these skills, and then think of the relative importance of making good decisions versus playing good tennis for these same individuals.

How good are people at making decisions? There is naturally a big range; some people are in general very good and others are not. However, almost everyone could make better choices.

There are many reasons for this. When one learns a skill by doing it, bad habits are naturally picked up along with good habits. Decision making is more complex than most other skills as there are many psychological traps that can cause our thinking to go astray.
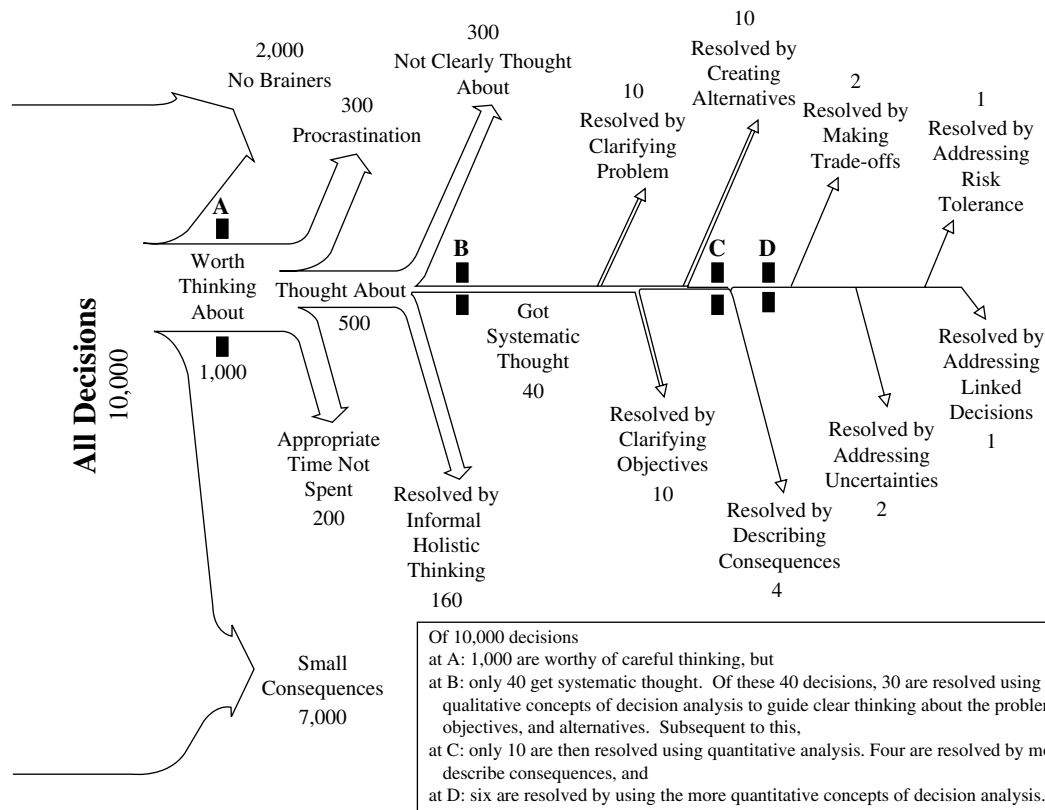
To many people, it is not readily apparent what is similar about selecting treatment for a serious medical problem, choosing which house to purchase, or what to spend your time on next at work. Rather than categorizing these choices together as decision-making situations, they think of these situations as being in different categories concerning staying healthy, managing the home, and contributing at work. Because these categories are dissimilar, it is difficult to transform skills from one decision situation to another. Hence, many people who are experts in one domain of making decisions are poor in others. A medical doctor who might make very good medical decisions on behalf of his or her patients may be very poor at organizational decisions or personal decisions. In fact, that same doctor might not be particularly good at making medical decisions concerning his or her own health. This is not so different from some of the well-trained decision analysts who are proficient at helping clients resolve their difficult decisions, and yet some of their personal decisions seem to go awry. They simply do not apply the principles of decision analysis to decisions worthy of thought in their own lives.

3. Decision Making Today

I define decisions as situations where the decision maker recognizes that a conscious choice can be made. Hence, decisions range from what pair of shoes to wear tonight, to should I wash the car, to where should we go on vacation, to what employee to hire, to where should the United States store nuclear waste. Figure 1 represents my judgment about how 10,000 of these decisions are typically made today. You can think of this as my personal histogram of 10,000 decisions being faced by numerous decision makers.

Of the 10,000 decisions in Figure 1, perhaps 7,000 have consequences so small that they merit little or no thought. Another 2,000 are "no brainers,"

Figure 1   A Description of How 10,000 Decisions Are Resolved

Of 10,000 decisions
at A: 1,000 are worthy of careful thinking, but
at B: only 40 get systematic thought. Of these 40 decisions, 30 are resolved using the qualitative concepts of decision analysis to guide clear thinking about the problem, objectives, and alternatives. Subsequent to this,
at C: only 10 are then resolved using quantitative analysis. Four are resolved by models to describe consequences, and
at D: six are resolved by using the more quantitative concepts of decision analysis.

where the appropriate choice is obvious. However, 1,000 decisions are worth thinking about, and these are the ones for which training would be useful. Of these 1,000 decisions, appropriate time may not be spent on about 200 and procrastination forecloses thinking about another 300. That leaves 500 of the decisions that are thought about. However *thinking* and *thinking clearly* are different, and thinking clearly about decisions is difficult. Most of those 500 decisions, maybe 300, are not clearly thought about. Another 160 are resolved through informal holistic thinking, and a well-thought-through choice is made. The remaining 40 decisions receive systematic analytic thought.

Decisions can be resolved by clarifying different complexities that may be the stumbling block to a decision. Of the 40 decisions receiving systematic thought, perhaps 30 are resolved by thoughtful qualitative structuring of the decision. Specifically, maybe 10 each are resolved by clarifying what the problem is, by clarifying what the objectives really are, or by creating

a very good alternative that seems like an obvious choice. After the qualitative structuring, perhaps 10 decisions are not yet resolved. These remaining 10 are resolved by quantitatively addressing other complexities of decisions by describing consequences, making tradeoffs, addressing uncertainties, addressing the decision maker's risk tolerance, and explicitly considering linked decisions. Many decision methodologies that are intended to help resolve decisions include describing the consequences. It is the other four features that are more explicitly and uniquely addressed in decision analysis. It is these elements that, when present, characterize what might be referred to as a complete decision analysis.

In terms of Figure 1, we begin with 1,000 decisions worthy of thinking about, and only about 40 of those might be resolved by what I think of as the systematic thinking of decision analysis. The other 960 get resolved in some other way, and most of the time it is not through a clear thoughtful process. Only 6 of the 1,000 are resolved as a result of an

Figure 2   A Prescription for How 10,000 Decisions Should Be Resolved
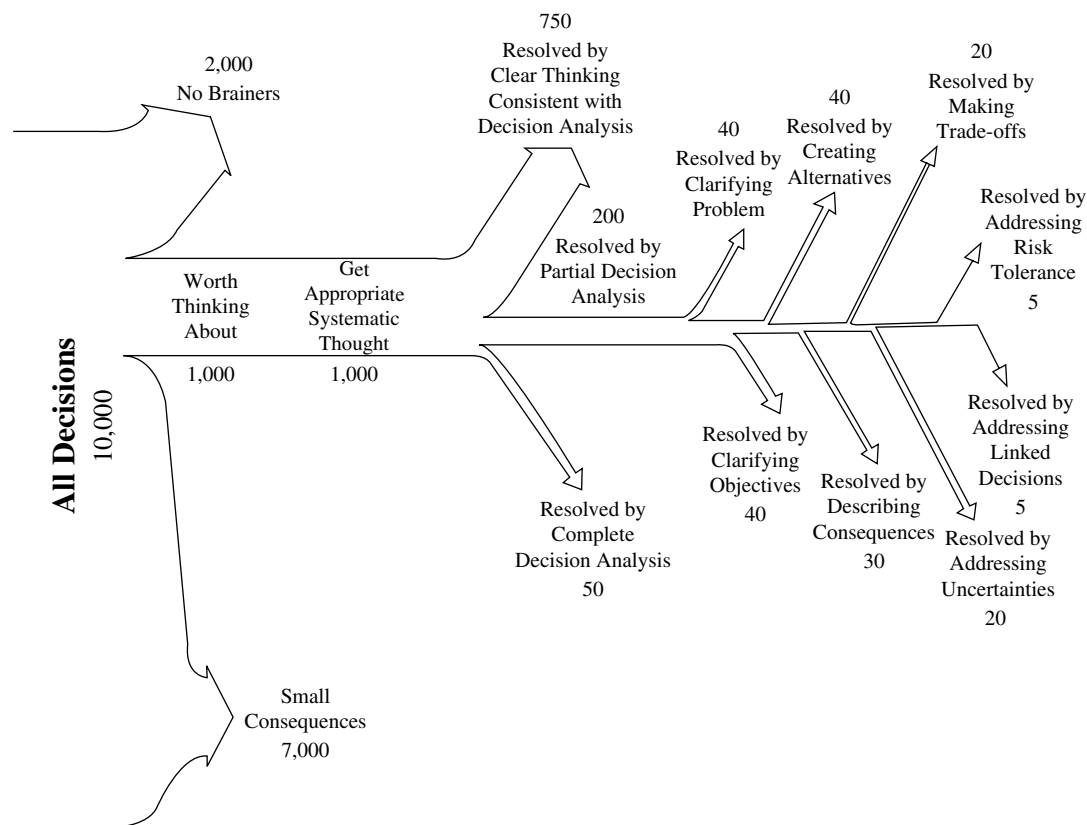
explicit quantitative decision analysis, and it is these 6 decisions that are the main focus of decision analysts today.

4.   Decision Making Tomorrow

The opportunity and challenge of the field of decision analysis is to have its concepts and ideas used on all of those 1,000 problems worth thinking about, rather than just 6 of the very complex ones that have an experienced decision analyst involved.

Figure 2 presents a prescription for how the 10,000 decisions in Figure 1 should be resolved. For the 7,000 decisions with small consequences and the 2,000 no brainers, no changes need to be made. However each of the 1,000 decisions worth thinking about would get appropriate systematic thought based on the concepts of decision analysis. My judgment is that about 750 should be resolved by clear thinking without even making lists. Another 200 decisions could be resolved by explicitly addressing specific complexities of the decision. This may involve writing out a

clear list of objectives, determining relevant probabilities, or specifying a value tradeoff. About 50 decisions, typically the most complex, would be worthy of a complete decision analysis, often with the assistance of a trained decision analyst.

The challenge that we in the decision analysis community face is to make the prescription of Figure 2 into a description of tomorrow's reality. Decision analysts will never, nor should they, be involved in all of the 1,000 decisions worth thinking about. The decision makers will have to solve their own decisions, as they have always had to do. Hence, if we want them to make better choices, they need to be trained to make better decisions. The decision analysis community is best equipped to do this training.

To train individuals to be good decision makers, we need to train them in a way that the ideas are relevant to all of the decisions that they consider worthy of thought. Hence, the basic elements that we teach need to be generally applicable to all decision situations. It would not work to have training relevant only to

particular classes of decisions such as investment decisions, medical decisions, or decisions with a single objective.

5. The Appeal of Decision Analysis

Decision analysis provides a solid foundation to meet the challenge of making better decision makers. This claim rests on the facts that decision analysis

- is based on common sense (i.e., think about objectives, alternatives, consequences, and tradeoffs) understandable to most people,
- has a formal foundation of logical axioms and their implied results,
- includes usable procedures to implement the concepts,
- simplifies decisions by breaking them into parts, but does not oversimplify decisions by neglecting complexities of specific decisions, and
- applies to all decisions.

When decision makers reflect on the decision analysis axioms, most conclude that they would like to behave in a manner consistent with them in their decision making. Hence, decision analysis has a very strong prescriptive appeal.

Many of the methodologies and procedures that claim to aid decision makers are not consistent with decision analysis. Specifically, any methodology or procedure that violates any of the fundamental axioms of decision analysis is not decision analysis. Typically, the way most decision tools violate decision analysis is by not addressing the real complexities of some decisions and by over simplifying the problem. Examples include the following: not listing the full set of objectives, not quantifying probabilities that describe possible consequences of an alternative, using worst-case analysis to choose alternatives, using the expected value of one objective such as expected profits to guide choice (when it is not verified that utility is linear in profits), optimizing with respect to one objective subject to constraints set on other objectives, avoiding "subjective factors" that are important to the decision, and simply choosing to rank the importance of objectives without knowing their ranges.

The general features of decision analysis can be categorized in four steps (Raiffa 1968, Bell and Schleifer 1995, Kirkwood 1997, Clemen and Reilly 2001). Step 1 structures the decision problem, which

Table 1   Elements of the Skill of Decision Making

1. Problem: Define your decision problem so that you will solve the right problem.
2. Objectives: Specify what you are really trying to achieve with your decision.
3. Alternatives: Create better alternatives to choose from.
4. Consequences: Describe how well each alternative meets your objectives.
5. Trade-offs: Balance pros and cons of different alternatives for meeting your objectives.
6. Uncertainty: Identify and quantify the major uncertainties affecting your decision.
7. Risk Tolerance: Account for your willingness to accept risks.
8. Linked Decisions: Plan ahead by effectively coordinating current and future decisions.

includes defining the decision problem being faced and generating sets of objectives and alternatives appropriate for the problem. Step 2 specifies the consequences of the alternatives by describing how well each of the alternatives measures up in terms of the set of objectives. Step 3 evaluates each of the various consequences to indicate which ones are better than others and by how much. Step 4 integrates the information from the first three steps to logically evaluate the alternatives. The thinking necessary to address these steps is categorized into the eight elements shown in Table 1 (Hammond et al. 1999).

Structuring a decision involves the first three elements: defining exactly what the decision problem is, specifying a set of objectives, and creating a set of alternatives for the decision. When there is no uncertainty, the consequences in Step 2 can be described directly by considering the implications of the different alternatives. When there are uncertainties, these need to be quantified using probabilities (Element 6). The consequences for each alternative are then described, along with each eventual set of resolutions of the uncertainties that impact that alternative.

In decisions involving multiple objectives, making value tradeoffs (Element 5) is part of Step 3. These value tradeoffs indicate the relative desirability of specified amounts of achievement on one objective compared to specified amounts of achievement on another objective. When uncertainty is involved, we also need to account for the risk tolerance (Element 7) for different specified amounts of achievement on the same objective. Technically, this is referred to as assessing a utility function.

The last element in Table 1—linked decisions—involves situations where a choice is made and then some uncertainty is resolved about what happens, and then another decision is made to account for what has happened, which may be followed by another resolution of uncertainty, and so forth. Structuring the choices and uncertainties that represent a decide-learn sequence, which is part of Step 1, can be laid out with a decision tree and is relevant to many complex decisions.

Each of the elements in Table 1 can obviously be broken down into components. For example, in specifying objectives (Element 2), one can identify the fundamental objectives, the means objectives, and the process objectives. The elements and their components give us a systematic way to think about all the various aspects that can make a decision complex. This allows us to think about one aspect at a time and then logically integrate our thinking together.

6. Comments on Decisions and Decision Analysis

As a decision analyst, I have learned a great deal about both decisions and their analysis. Here, I want to stress some facts that I believe provide the basis for why and how we should expand the role of decision analysis from helping to make good decisions to helping to make good decision makers.

The only way that individuals can purposely exercise any control over their lives, their careers, or their surroundings is through their decision making. Going through one's life is analogous to following a path. A decision point in life is analogous to a fork on the path where one chooses which way to go. Imagine that path with no forks anywhere. All you could do is continue on that path forever with no influence. The same would be true of your life with no decision points. None of us would desire to be in such a situation.

It is important to make good decisions. Why do we even care about making any decisions? Making decisions takes effort and time. Why not let what will happen simply happen? The reason is that we care about the consequences of our decisions. We naturally prefer good consequences to bad consequences, where good and bad are defined by our values that indicate what we hope to achieve. The only way we

can better achieve our values is by controlling our decisions. If you want to have better consequences, you must make good decisions that, on average, have those positive effects. Also, as we all know, the consequences of poor decisions are sometimes terrible. By making good decisions, we cannot guarantee good consequences rather than poor consequences because of the uncertainties involved, but we can do much better on average and decrease the chances of terrible consequences.

Subjective aspects are a critical part of decisions. Defining what the decision is and coming up with a list of objectives, based on one's values, and a set of alternatives are by nature subjective processes. You cannot think about a decision, let alone analyze one, without addressing these elements. Hence, one cannot even think about a decision without incorporating subjective aspects.

To analyze alternatives, one typically requires a list of key uncertainties, assessments of probabilities for these uncertainties, a decision tree, value tradeoffs, and a quantified attitude toward risk. Subjective judgment is necessary to specify each of these.

Once you have addressed all the subjective aspects in a decision and those necessary for an analysis, some analysis can be done. Sometimes people refer to such an analysis as "objective analysis." However one should always keep in mind the perspective that the foundation for decision making is and must be based on subjective information.

It is good that decisions have subjective aspects. There are those that would like to avoid the subjective aspects and make "objective decisions." However, if there were such a thing as an objective decision that did not require any subjective input, we would literally not have any control over the decision. The intent would be to find the objective answer and that would be all we would need. Indeed, we could program computers, or have others smarter than we are program computers, to make our decisions for us.

Focused thinking, aided by appropriate analysis, can help make good decisions. It is very hard to make good decisions intuitively in complex situations. This does not mean that one should disregard intuition, but that one should complement intuition with focused thinking on elements of the decision. When one's intuition and analytical thinking conflict, and the difference

matters, additional thought to try to understand and resolve the conflict should be illuminating. It is important that thinking concentrates on the more difficult aspects of a decision and on the subjective aspects of a decision. Clarity can often lend the most additional insight to these aspects.

Sometimes interactions of aspects of a decision are so complex that analysis is worthwhile. If the value judgments and the other subjective aspects relevant to a decision are explicitly considered in a systematic manner, then they typically are not the weak parts of an analysis. As a result they also will not be the weak parts of one's thinking about what the best choice is. On the other hand, if one avoids these values and subjective aspects because it is not clear what to do because they are so subjective, then any analysis is often close to worthless. The weakest part of this process is the lack of thinking on the subjective components of the decision.

Prescriptive decision analysis is as relevant to group decisions as it is to individual decisions. The intent of decision analysis is to provide insight into what the best decision is and why in any given situation. The axioms of decision analysis indicate how to analyze the decision problem, not where the information comes from to analyze. Whether a decision problem is one that is faced by an individual or by a group, the elements of the decision are the same. Hence, decision analysis has the potential to lend insight into either group or individual decision problems.

In practice, when a group is responsible for a decision, members of the group may have different values, different judgments about other subjective aspects, and/or even different data. One could repeatedly use the same decision analysis model with the different values and information of the various group members to clarify which differences among members are relevant to identify the best course of action for the group. Such analyses of a group decision would provide guidance for systematically discussing differences to logically arrive at a better choice.

A normative model that suggests a common rationality is often not appropriate for prescriptive use. Normative models for decision making usually suggest that all individuals should behave consistently with the model. Typically, these models specify the objectives in the form of an objective function. If this set of objectives is not appropriate for a particular individual or group facing that decision, then the model is not prescriptively appropriate for that decision.

I have heard the claim that individuals who are risk averse for money, yet gamble in Las Vegas, are inconsistent. Indeed, I have heard people claim that decision analysis is not valid because of inconsistencies like this. I have asked some of these people whether they themselves have a risk averse attitude toward money. Typically, they say yes. Then, I ask them if they would ever gamble in Las Vegas. They often say no, because this would be inconsistent with risk aversion. Then, I ask them if they ever go to see movies. They say yes. I point out that going to a movie is guaranteed to result in the loss of money, whereas gambling in Las Vegas at least has a chance of coming out ahead. I ask them how they can possibly go see a movie when they know they are going to lose money. Well, the answer is obvious; they say they enjoy movies. Hopefully, the answer about the possibility of gambling in Las Vegas is obvious. If you enjoy the process, spending an evening gambling and losing say $200 may be preferable to not spending that evening gambling. The normative model does not account for the multiple objectives in this case. A prescriptive model should.

Descriptive decision research complements prescriptive decision analysis. We are all aware of the research that indicates that individuals often do not make decisions in a manner consistent with common sense or decision analysis. On the other hand, when people understand and carefully think about the axioms of decision analysis, they often want to behave consistent with them on important decisions. Hence, the descriptive research shows both how difficult it is to intuitively behave in a manner consistent with those assumptions in all decisions, and provides us many examples where our intuition can go awry. The descriptive decision research suggests what many of the problems of applying prescriptive decision analysis are and how we can better account for them and understand their relevance in our decision making. More generally, it indicates how worthwhile prescriptive analysis can be.

Insights about a decision, not definitive choices about what to do, are the key products of focused thinking and analysis. Decision analysis provides answers for the

model you have built of your decision problem. It does not provide answers for your decision problem. The model is and should be simpler than your real problem, yet complex enough that you cannot clearly think through it with unaided intuition. The analysis helps you think through that problem and provides insights from the answers to the model. You must then take these insights and consider their relevance and strength in influencing your thinking and the choices that you should make regarding the decision you face.

7. Broadening What Decision Analysis Should Offer

It is useful to compare what decision analysis has had to offer with what it can, and I think should, offer today. Over the past few decades, decision analysis has been used, often with the aid of a professional decision analyst, on particularly complex problems—namely, those six of 1,000 decisions past threshold D in Figure 1 (see, for example, Howard and Matheson 1983, von Winterfeldt and Schweitzer 1998, Clemen and Kwit 2001, Keeney and Lin 2000). Decision analysis should provide the basis for decision making for all the decisions worthy of thought in Figure 2. For most of these decisions, it is impractical to have a decision analyst involved. The decision makers must make their own decisions without the help of others. The role of decision analysts should be expanded from helping to make good decisions to helping to make better decision makers. For this, my thinking has expanded to include the following principles.

Decision analysis should guide all of our thinking about decisions. I used to think of decision analysis as common sense for solving difficult decision problems. This common sense was embodied in axioms, models, and procedures for implementation on those difficult problems. Now I think that the more important role for decision analysis is a way of thinking through any of the decisions you face. With much of decision analysis, such as understanding your objectives and creating alternatives, you do not need axioms. With other parts of decision analysis, you do not need procedures or models. You need clear thinking directed at the elements of decisions and at combining those elements to gain insights about your decision.

I used to think that decision analysis helped solve decision problems, but now I include figuring out

what the decision problem is as a key, and perhaps the most important, part of decision analysis. The first element of figuring out a decision problem is to define it carefully, that is, to frame it. The next two elements are characterizing it by a complete set of objectives and a full range of alternatives relevant to that decision. These two elements, concerning objectives and alternatives, have always been a part of decision analysis. What I believe is different now is that one should not take them as given, and then proceed with a more formal and quantitative analysis of consequences and value tradeoffs, uncertainties, and so forth. Rather, one should explicitly and systematically develop appropriate objectives and spend time to create viable alternatives that are not readily apparent (Keeney 1992).

I used to think that quantitative aspects were the most important parts of any decision analysis. Now I believe that the qualitative parts are the most important. If you do not have the right problem, objectives, alternatives, list of uncertainties, and measures to indicate the degree to which the objectives are achieved, almost any analysis will be worthless. No quantitative analysis has ever been done that did not rest on a foundation of qualitative structuring. Furthermore, by being clear about the qualitative aspects, one can resolve many decision problems without an analysis. If your objectives are made crystal clear, the best alternatives may be obvious. If you create an alternative that is terrific, just choose it and that decision problem is over.

I used to think that in doing a decision analysis, one should go through each of the steps in a sequential manner first. Then, one would do an analysis and sensitivity analyses subsequently that varied several of the inputs. Now I believe that there should be much more interaction among the steps to resolve a decision. Essentially, one is making a series of choices as they examine any decision problem. One should be working on the aspects of the decision that contribute most to decision quality at any particular time (Matheson and Matheson 1998) given the insights and knowledge that we have at that time. Once those aspects are better understood, one focuses on other aspects to enhance decision quality and moves on to resolution.

With decision analysis formally characterized in my mind more by axioms, models, and procedures,

I thought of it as almost a science. It is clear from this paper that I now think of it much more as a skill, and this different framing is relevant to much of what we do in trying to teach our discipline.

Decision analysis is useful for resolving all decisions worth thinking about. One could not and should not analyze all the decisions worth thinking about using the formal procedures of decision analysis. It would simply take too much time and not be worth it. With scarce resources, it was natural to work on the very difficult decisions, as they were too complex to think through in an informal manner.

As decision analysis is more generally thought of as a way of thinking about decisions, it can naturally be applied much more broadly. Application does not mean doing a formal analysis. Application does not mean going through each of the elements on every decision. It means explicitly and logically addressing those aspects of the problem that are hampering the clarity to make a smart choice.

I used to believe that the more accurate an analysis was, the better. While this is certainly still true, it is not so important. I now believe that rough analysis is often sufficient to make good choices in most decision situations. This judgment is very relevant to the next point.

I used to believe that selecting the best alternative in any decision situation was important. While this is certainly very nice, I now feel that it is perhaps more significant to eliminate the bad alternatives from decisions. This is perhaps an easier standard to meet than trying to find the best in each situation. Consider how well any of us would probably be doing if in all of our decisions, we were only choosing among the best two or three alternatives or among the best say 15% of the alternatives when many competing alternatives were available.

Decision analysis should reduce the implications of the cognitive and psychological errors that influence decision making. When I began working in the field of decision analysis, I felt that people routinely used common sense in decision making. The principles embodied in the axioms were so reasonable that anybody would naturally follow them when they gave a decision even a little bit of thought. Then, behavioral decision research enlightened me about many of the problems that people have in applying common sense to

their decision making. I first felt that these "cognitive illusions" and "psychological traps" were interesting and important, but relevant only to specific situations. I now believe that the spirit of all of these traps applies to all aspects of thinking about decisions. We, myself included, sometimes do not even recognize them.

Our decisions are often unconsciously framed; yet the frame influences all subsequent work to resolve the decision. For example, Tim McDaniels and I were finishing a joint project a few years ago. We initially thought that two more days of work by each of us would be sufficient to finalize our project. Because he lived in Vancouver and I in San Francisco, we unconsciously decided that this was the same as a two-day meeting and began to look for such opportunities. We checked calendars, and there were no two-day periods available in the near future based on our schedules. Only this forced us to recognize our implicit assumption that the two days needed to be consecutive. Then, we looked for pairs of two single-day meetings, and this too proved to be problematic. We began to recognize that we had inappropriately required two days as a constraint. Finally, we backed up to the objective of our decision—How do we effectively finish the project? The alternative we eventually ended up with involved much more communication via phone, e-mail, and fax and only a six-hour personal meeting at the end. This was probably better than a two-day meeting, which would have been our chosen alternative if we could have found such an alternative in the beginning.

Related to the above, I used to think that we wanted to learn how to avoid psychological traps. That is certainly still relevant if we can do it, but I believe that there are many of these psychological traps that we cannot avoid. Hence, we want to be aware of where they are most likely to occur and minimize the negative impact of their occurrence. Then, using concepts of decision analysis like focusing on objectives and creating alternatives, take steps to reduce their implications in these situations.

Decision analysis should be the foundation to train better decision makers. With the past characterization of decision analysis, its main value was to apply it to complex decisions and choose a better alternative than what would have happened without analysis and hopefully ensure that the chosen alternative is one of

the best. However, such analysis can only be applied to a few decisions, perhaps just 6 of the 1,000 decisions worthy of thought described in Figure 1. With broader characterization of decision analysis as a way to think through problems worthy of thought, it can be applied to all 1,000 such decisions.

There are some rather sophisticated concepts, techniques, and procedures needed to apply decision analysis when the problems are particularly complex. A person without substantial training is unlikely to be able to carry out the analysis well. Hence, my old notion was that a decision analyst typically needed to be involved to conduct a decision analysis. This is worthy of a short story.

I recently presented a two-day intensive course to an organization's nuclear research group. I was told that the major purpose of the program was to teach them how to apply decision analysis so they could use it right away when selecting experiments and allocating research funds. I mentioned that I was becoming interested in nuclear science and had some ideas on some big experiments that I thought I would like to conduct. I asked if I could possibly stay over for two additional days and have a training program on nuclear science so I could come back home and then proceed with that research. They recognized the analogy. In a discipline like decision analysis, where you typically get a Ph.D. to become proficient, you cannot become reasonably proficient with two days of effort or just one course. However, you can learn some very useful concepts and procedures to improve your decision-making skills.

I think we should have introductory courses in decision analysis that prepare individuals to use the procedures, concepts, and insights of decision analysis on all of their own decisions. On their very complex decisions, they might want to engage the help of a decision analyst. If they understood our concepts and the value of thinking through decisions using decision analysis, they would certainly be much better trained decision makers, as well as better partners and consumers of decision analysis.

8. Practical Implications

There is a lot we need to learn if we want to effectively use decision analysis to help people become better decision makers. Some key aspects include the following.

Understand what decisions people care about. In training programs for corporations I have asked people to list the five most important decisions they have made in the last five years. I would guess that 75% of those decisions are personal decisions rather than corporate decisions, even given the corporate setting where the training was taking place.

The decision maker's perspectives matter. We need to understand what the important decisions are that people are making. It would be nice to have this information for different groups of individuals. What are the important decisions that top management in corporations are making? What are the important decisions of 15-year-old teenagers, of entering college students, and so forth? We also need to know what people believe are the most difficult (as contrasted to important) decisions that they make and what they find to be the most difficult parts of those decisions. We need to know how decision makers think about and address these difficulties.

It is very important to understand what kind of help people need within their decision making. Closely related, but different, we need to understand what kind of help people are willing to accept concerning their decision making and from whom they might accept that help.

Develop concepts, tools, and procedures to help decision makers. My experience is that many people, including well-educated people, have a very difficult time in structuring their decisions. They can get mixed up about the difference between fundamental concepts such as alternatives and objectives. I have had graduate students tell me that an important objective in a decision concerning what to do between semesters is to go home over Christmas vacation. I asked them who controls whether or not they go home. They say that they do. I point out that going home is therefore an alternative, not an objective, because it is under the control of the decision maker. Once you have all the concepts of decision analysis down, such distinctions are usually easy to make. I do not think that they are easy to make for many untrained decision makers.

We need better ways to address the softer aspects of decisions. These softer aspects have many names such as intangibles, subjective components, squishy stuff, and so forth. However, they are important, and frequently they are the most important aspects of

decisions. A part of this is just getting decision makers to understand that it is desired, rather than inappropriate, to include subjective components in their decision making.

Broaden our understanding of psychological traps. As mentioned earlier, I think many of the psychological traps that have been studied on the more concrete aspects of decision problems are relevant to the softer aspects such as defining the decision problem, selecting objectives, and creating alternatives. If one is in a brainstorming session and an individual suggests an alternative, many people start thinking about that alternative and tend to come up with alternatives that are more similar to it than they may have otherwise done. I have observed this and conducted informal experiments in group settings to recognize that individuals anchor on existing alternatives in creating new alternatives.

Psychological traps also affect one's perceived values. A simple experiment I have conducted with many people is the following. I ask them if $50,000 tax-free per year is sufficient for them to live comfortably in retirement. They are to answer yes or no. Then, I ask them how much tax-free money per year would be sufficient to live comfortably, and they give an answer. Another set of people get the same two questions, but I use $100,000 in the first question. On average, the people who begin with the $50,000 question need around $75,000 per year to live comfortably, while those who began with the $100,000 question need $160,000 on average to live comfortably.

Such anchoring when expressing judgments such as these can be crucial. Imagine going to a financial planner when you are about 55 years of age and asking about how you are doing with respect to financial well-being in retirement. The planner knows that how well you are doing depends on how much money you need. So, soon into the discussion, the planner might ask, "How much money do you need per year in retirement?" You could say, "I'm not sure," and he or she might ask, "Well, is $50,000 per year enough?" Eventually, you get to an annual need, but your response will likely be heavily influenced by the $50,000 anchor. This response, if used as a basis for future retirement planning and action, could clearly have a major influence on well-being in retirement. Yet, none of us want important decisions such

as financial planning in retirement to depend on the nuances in the discussion of such planning.

Use real decisions, not just laboratory problems, in decision research. We have learned a great deal from all the laboratory settings where decision experiments have been conducted. There have also been some research studies of real decision problems. I feel there is much more to be gained by having more of this type of research. We cannot necessarily hold many variables fixed for real decisions, nor can we meet the standards of controlled experiments in such settings. However, we greatly increase our potential for learning what is critical to help make people become better decision makers.

In this process, we should learn more about how to promote the learning, understanding, and use of the concepts and insights of decision analysis. If we had several individuals explicitly use and document our ideas to solve many of their problems worthy of thought, we could examine these to find out which things that we were teaching seemed to be having the best impacts and why.

Teach people what they can and will learn and use. As stated earlier, hundreds and thousands of people have had at least a course that included a substantial part on decision analysis and very few have probably ever conducted a formal decision analysis. Once we find out what people can and will learn and use, that should constitute the basis for much of our teaching of decision analysis. Some might feel that I am suggesting that we should set a lower standard, and this is true if a lower standard means a less quantitative one. However, this might be considered a higher standard in terms of influencing the way people think and ultimately how they manage their lives and careers.

What we would teach in a basic course is how to apply the concepts of decision analysis to all of one's problems worthy of thought. We would teach the elements outlined in Table 1 so that people could use them when appropriate and use only one element on a problem for which that was appropriate. Then, people might become somewhat familiar with the language, concepts, distinctions, and value of decision analysis. If that happened, for those problems where many elements were critical and the complexity was too large for the person with a basic understanding of decision analysis, they may more readily elicit the

help of a decision analyst. Of course, we would still like to train decision analysts and have them available to make those contributions.

9.   Is It Worth It?

Is it worth trying to teach people to become better decision makers? I think the answer is a resounding yes because the only way that people can purposefully influence their lives is through decision making. If we can help people become better decision makers, that would make a substantial difference in their lives and in the lives of those that they affect.

There is a strong argument that decision making should be considered a primary skill. All the knowledge that we teach in high schools and universities—for example, in engineering, science, business, law, and medicine—is to provide substance to make better informed choices and, therefore, hopefully better choices. However, what we generally do not provide is the guidance for how to use that knowledge to make those choices. Without those choices, people cannot have any influence on anything. Learning the skill of decision making is primary; how else can we be better students, better parents, better neighbors, better citizens, or have better lives? By training

people to be better decision makers, the field of decision analysis can have a far greater impact compared to helping resolve relatively few very important decisions.

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