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Complex Decisions made simple with
structure and tools



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Complex Decisions Made Simple with Structure and Tools

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Introduction

It is through structure that complex decisions are made manageable. Structuring techniques allow multiple considerations to be compared in a coherent and consistent way and for the results of analysis to be illustrated. These techniques include everything from spreadsheets to regression analysis. One example of a simple structuring technique is to create a shopping list.

Structuring techniques are the foundation of decision making. They are to decision making what blueprints are to construction. Structuring techniques illustrate complex problems so that options can be compared in a logical fashion. There are a number of techniques that will quickly and easily improve the quality of analysis of virtually any problem. This paper introduces some of the simplest and most effective structuring techniques including sorting, sequencing, placement, decision trees, and ranking.

The Discussion So Far

In the first white paper in this decision-making series, [*What Is a "Good" Decision? How Is Quality Judged?*](#) we defined a "good" decision as the solution that has the highest probability of the most desirable outcome. It requires that all possible alternatives be identified and then evaluated objectively.

In the second paper in the series, [*How to Overcome Analytical Bias to Become a Stronger Decision Maker*](#), we described how bias, mental laziness, and stereotyping subvert our ability to be objective. In the [*third paper*](#) in this series, critical thinking was introduced as the cure for shallow and superficial thinking. Critical thinkers pursue reason and logic as the foundation for effective decision making. They "think hard" rather than thinking quickly.

The [*fourth paper*](#) in the series describes a ten-step pathway to making more effective, objective, and balanced decisions. These guidelines help to counterbalance the mind's tendency to make decisions based on biases, assumptions, and a narrow point of view. The [*fifth paper*](#) elaborated on the contribution and techniques of creativity in decision making.

Structuring Techniques

Imposing structure on our reasoning helps us to make sense of complex problems by comparing elements of the problem in a comprehensive rather than scattered way. This sixth and final paper in the critical-thinking series, describes a few simple structuring techniques and explain how these technique are used to arrive at better, more fully understood, decisions.

This discussion begins by describing the most basic of tools (sorting) and follows with examples of simple but effective ways to look at problems in systematic ways. It concludes with a very commonly used tool (ranking) that can be easily improved by applying a technique called paired ranking.

Sorting

Sorting is the most basic structuring technique. It involves grouping data into patterns of association. For example, grouping similar items on a grocery list is a technique to simplify finding them in a store. When working on a problem, we all tend to sort information in our heads. However, for the greatest clarity, recording the information on a list that can be viewed and rearranged is a better approach. It provides a visual perspective and a written record that can be edited, re-sorted, and augmented. Sorting contributes to the understanding of even the simplest of problems (such as shopping) and allows us to ask questions of the data, such as: Are there enough items needed from a different store in order to justify driving to that store?

Sequencing

Sequencing is a form of sorting. With sequencing, events are put in chronological order to create a visual understanding of how events relate to each other temporally. There is a familiar logic to sequencing because humans tend to think chronologically. Newspaper and magazine articles report information in time sequence because it helps us to understand the relationships of events. The same is true for problem analysis.

The objective of sequencing is to create a visual depiction of events and their relationships in time. From this display it is possible to see aspects of a problem that would otherwise remain invisible. For example, crimes are typically analyzed in order to understand the chain of events that occurred.

Placement

Richard Neustadt and Ernest May coined the term *placement* in their highly informative book *Thinking in Time: The Uses of History for Decision-Makers*, The Free Press, 1958. Their structuring technique was a specialized form of a timeline, in which parallel events are arranged in parallel columns to illustrate relationships and implications between the events. Neustadt and May were primarily concerned with political decision making, but the technique can also be applied to common problem solving. Placement is an effort to illustrate relationships between events so as to imply cause and effect. This form of problem analysis is common in criminal investigations. The timing and location of events relating to a crime are compared with the timing and location of activities of a particular suspect. If the two overlap sufficiently, the police naturally assume a cause-and-effect relationship and therefore investigate or analyze further.

A similar approach can be taken to analyzing the events associated with any problem. Various types of data relating to the problem are compared from a chronological perspective in order to determine if there are any patterns that suggest causations. Studying the causes and effects within a problem helps to validate or invalidate our gut reaction to a problem. Like other structuring techniques, it provides a valuable check on biases and mindsets that mislead our thinking.

Matrices: Grids of Cells

Matrices may sound complicated, but they are not. A matrix is a merely a grid or table. Matrices are among the simplest forms of analytical structures. They allow information to be sorted into a vivid, visual package that greatly enhances understanding through relatedness. One example of a matrix is the distance table between cities provided on a map. Cities are listed alphabetically on the top row. This same list also appears on the vertical side. In the grid below and beside the city names are the distances between every pair of cities. By plotting distances and locations in a grid, a huge amount of information can be condensed and organized into a small space.

The development of a matrix is the process of condensing important information into a table that shows relationships (such as the distance between cities). Once information has been entered into a matrix, it is immediately easier to comprehend and interpret.

The benefits of matrices are manifold. The elements of a problem are isolated for comparison and analysis. Information is categorized, allowing for comparison within and between information types. In addition, the visual display of data allows patterns or correlations to be more easily detected. A matrix is a useful tool even when data is not complete. Setting up a matrix illustrates the gaps or empty cells in one's knowledge or understanding of a problem.

Decision Trees

Decision trees are graphical representations of choices that can be made and the outcomes that may result. Using a decision tree is an excellent technique for depicting scenarios. Each branch of the tree represents a different set of choices and therefore a unique possible outcome. In order to analyze a problem using a decision tree, the choices involved must be mutually exclusive. If you choose one, the other is not and cannot be chosen. Decisions involving partial choices, where fractions are an option, will not work with this technique. Another requirement is that the tree be drawn so as to be collectively exhaustive. In other words, the branches emanating from a decision must include all possible outcomes.

Creating a decision tree involves four steps:

1. Characterize the problem in terms of where decisions must be made in relation to what branches need to be created.
2. Identify the choices for each branch.
3. Test each branch to determine if it leads to a logical conclusion. The test for completeness is whether the branches include all possible outcomes.
4. Avoid shortcuts. Some branches or choices will seem obviously inappropriate and the tendency will be to not include them in the diagram.

However, this tendency to ignore obviously bad decisions is the manifestation of a biased mindset, and it must be fought. Preconceptions should not be permitted to influence which aspects of the problem (which scenarios) receive further analysis. Be careful to include all possible options and give them all a fair hearing in your analysis.

Introducing Probabilities to Decision Trees

Essentially all types of decision making benefit from probability analysis. Whenever we run out of hard data and start to rely on estimates, we have entered into the arena of probability. Unfortunately, the logic of probabilities is not intuitive for most people. The language and logic of probabilities must therefore be studied in order to make it useful as an analytical tool.

Decision trees offer a simple and effective way of introducing probability analysis into decision making in an easy to understand format. The addition of probabilities to a decision tree changes the focus from what *might happen* (can and cannot) to what is *expected to happen* (likely or unlikely). It enables us to determine which scenario (or branch of the tree) is most likely to occur, and which is least likely.

The creation of a probability tree follows the same rules for a decision tree, with the added step of introducing probabilities to each of the branches. The probabilities at each node must add up to one. In other words, the choices must include all possible outcomes. They must be collectively exhaustive. In order to better understand how probabilities are added to decision trees, we must first become familiar with the terminology such as mutually exclusive, conditionally dependent and the math of probability.

Mutually Exclusive

Mutually exclusive events have distinct choices. One example would be the tossing a coin. While it's equally possible that one side or the other will land face up, it is impossible for both sides to land face up. The total probability of all possible outcomes is one, or 100 percent.

When rolling a die, there is a one in six chance of a particular number being thrown. The probability of any particular number being thrown is $1/6$, or 16.7 percent. The occurrence of any one of the numbers being thrown is mutually exclusive of any other number appearing. All numbers have an equal chance of being thrown. The total probability of all six options is cumulative, and adds up to 100 percent.

Conditionally Dependent

Conditionally dependent events are those that must occur in sequence. The probability of each step occurring is not determined by the previous steps. However, the probability of a particular series of steps taking place is determined by the total probability of the sequence.

An example of conditionally dependent events is the tossing of coins with the intention of getting two consecutive heads. Each of the tosses is a mutually exclusive event with its own probability (50/50), but predicting the outcome of two coin tosses in a row makes the two tosses conditionally dependent.

Probability Math

For mutually exclusive events, probabilities are added. This is why the probability of all events at a node in a decision tree must add up to one, or 100 percent. If the probabilities of the branches add up to less than 100 percent, then some possible outcomes have not been included. If the probabilities add up to more than 100 percent, then some possibilities have been included that cannot actually take place.

The probabilities along a conditionally dependent pathway are multiplied. The probability of tossing two heads in a row is the product of the probability of the first event ($1/2$, or 50 percent) multiplied by the probability of the second event ($1/2$, or 50 percent), for a total pathway probability of $1/4$, or 25 percent.

What is the probability of rolling two dice that both come up as ones? It is the same as rolling one die after the other and trying to get a one with each event. The rolling of snake eyes, therefore, is a conditionally dependent event. Even though the two dice are thrown at the same time, one die must turn up as a one *and* so must the next. These are not simultaneous events but are sequential, even though they do not seem like it.

The probability of any particular number coming up on the die is $1/6$, or 17 percent. When one die is rolled, there are six possible outcomes, or branches to the tree. Each of these outcomes has six more branches to represent the second roll of the die. If all branches of all options were drawn as a decision tree, there would be thirty-six branches. This implies that there are thirty-six possible outcomes that can occur when rolling two dice. The probability of any particular combination is the product of the probability of the first event and that of the second event (17 percent $\times$ 17 percent), which is the same as saying $1/36$, or 3 percent. The trick to understanding the math of probabilities is to clarify whether the events are mutually exclusive (this *or* that) or conditionally dependent (this *and* that). Then, the math is easy.

Ranking

Ranking is the assignment of position of one thing (choice, action, or alternative) relative to another. Ranking is something that we all do regularly. When deciding on where to eat lunch, we rank the options in our heads (subconsciously) before making a choice. Not only do we rank regularly and easily, we are skilled at changing the ranking criteria as the need arises. The criteria used to sort options one day can be completely different on another day, for the same decision. Today, the priority for lunch is speed, so the choice is fast food. Tomorrow, the preference is fine dining because someone else is paying.

Our ability to rank quickly and easily is vital to everyday routines. Deciding on breakfast, what route to drive to work, or which outfit to wear are all subconscious ranking activities. Everyone has instinctive ranking capabilities and uses them constantly.

That's the good thing. The bad thing is that, like other instinctive mental traits, we tend to be inconsistent. The criteria used to rank are not consistently applied and are regularly changed within the same ranking session. These imperfections are of little consequence to most daily decisions, but can have very negative effects when important decisions are involved.

Fortunately there is a simple cure for our propensity to err. Pair ranking is a technique that takes advantage of our innate ranking skills, but overlays an analytical structure that ensures we are consistent. The objective of pair ranking is to ensure that ranking criteria is equitably applied in all comparisons. It breaks all ranking sessions down to simple comparisons between all possible pairs. The option that emerges with the highest score from the individual comparisons is the preferred choice.

The first step is to prepare a list of the choices or alternatives that are to be ranked, such as a list of movies that you are trying to organize in preferential order. The next step is to compare every possible pairing. The winner of each paired ranking gets a point.

For example, compare the movie *Gone with the Wind* one-to-one with several other movies. Give *Gone with the Wind* a point if it wins the comparison (as the preferred movie); if not, the other movie gets a point. Each movie in turn is compared one-to-one against all others, and a point is awarded to the winner of the paired comparisons. After all of the paired rankings have been completed, the movie with the most points is the favorite of those being analyzed. The results may be surprising but are not controversial.

Conclusion

Structuring one's analysis forces one's logic out into the open and helps to illustrate a method to the madness. Structure reveals what complexity obscures. The benefits of structuring one's analysis of a problem are many. It:

- reduces the apparent complexity of problems down to manageable chunks;
- allows the comparison of individual elements rather than clusters of elements;
- allows the mind to focus on individual elements but not to remain focused on any one element to the detriment of other considerations; and
- provides a visual basis for reasoning and reasoning through a problem.

Good decision makers use structuring techniques all the time. Structure is essential to comprehension. The techniques do not need to be complex; they just need to be appropriate. Structure does not replace analysis; it is the bread and butter of analysis. Structuring techniques portray complex information in ways that can be more readily interpreted. It is through structure that complex problems become manageable. Techniques that reveal relationships and patterns will help to reduce complexity and lead to more informed decisions. And more informed decisions are better decisions.

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About the Author

Brian D. Egan has been a contract instructor for Global Knowledge since 1999. He divides his time between management consulting, project management, technical writing, and professional development training. Brian is a "serial entrepreneur." He has started companies in such diverse fields as fish farming, woodworking, gift manufacturing, and catering. He is the author of numerous training courses relating to professional skills, project management, and decision making.