Chapter 2

Problem Solving and Decision-Making

Problem Solving

For some, problems are opportunities in disguise. For others, problems cause worry. In his book, *How to Stop Worrying and Start Living,* Dale Carnegie included a chapter entitled "How to Eliminate Fifty Percent of Your Business Worries."[1] Rather than tell a story about a Mr. Jones, or a Mr. X, Carnegie relates the experience of a real person, Leon Shimkin, in Shimkin's own words. (Shimkin was a former partner and general manager of one of the foremost publishing houses in the United States: Simon and Schuster.)

> "For fifteen years I spent almost half of every business day holding conferences, discussing problems. Should we do this or that—or nothing at all? We would get tense; twist in our chairs; walk the floor; argue and go around in circles. When night came, I would be utterly exhausted. I fully expected to go on doing this sort of thing for the rest of my life. I had been doing it for fifteen years, and it never occurred to me that there was a better way of doing it. If anyone had told me that I could eliminate three-fourths of the all the time I spent in those worried conferences, and three fourths of my nervous strain – I would have thought he was a wild-eyed, slap-happy, armchair optimist. Yet I devised a plan that did just that. I have been using this plan for eight years. It has performed wonders for my efficiency, my health, and my happiness. It sounds like magic – but like all magic tricks, it is extremely simple when you see how it is done.
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> Here is the secret: First, I immediately stopped the procedure I had been using in my conferences for fifteen years – a procedure that began with my troubled associates reciting all of the details of what had gone wrong, and ending up by asking: 'What shall we do?' Second, I made a new rule – a rule that everyone who wishes to present a problem to me must first prepare and submit a memorandum answering these four questions:
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> Question 1: *What is the problem?* (In the old days we used to spend an hour or two in a worried conference without anyone knowing specifically and concretely what the real problem was. We used to work ourselves into a lather discussing our troubles without ever trying to write out specifically what our problem was.)

[1] Carnegie, Dale, How to Stop Worrying and Start Living, 1944,1984 Pocket Books, New York, N.Y.

> Question 2: *What is the cause of the problem?* (As I look back over my career, I am appalled at the wasted hours I have spent in worried conferences without every trying to find out clearly the conditions, which lay at the root of the problem).
> Question 3: *What are all possible solutions of the problem?* (In the old days, one man in the conference would suggest one solution. Someone else would argue with him. Tempers would flare. We would often get clear off the subject, and at the end of the conference no one would have written down all the various things we could do to attack the problem.)
> Question 4: *What solution do you suggest?* (I used to go into a conference with a man who had spent hours worrying about a situation and going around in circles without ever once thinking through all possible solutions and then writing down, 'This is the solution I recommend.')
> My associates rarely come to me now with their problems. Why? Because they have discovered that in order to answer those four questions they have to get all the facts and think their problems through. And after they have done that they find, in three fourths of the cases, they don't have to consult me at all, because the proper solution has popped out like a piece of bread popping out from an electric toaster. Even in those cases where consultation is necessary, the discussion takes about one third the time formerly required, because it proceeds along an orderly, logical path to a reasoned conclusion."

Not only will better problem skills result in less worry; they will lead to more successful problem solving. In *Building Team Power*[2], Thomas Kayser suggests six steps for achieving problem solving success. The methodologies we present here will help you implement parts or all of these steps:

Step 1) Defining and selecting the problem. View the problem as a GAP or difference between the current condition (as is) and some future condition (what should be).

- DO specify the extent of the problem.
- DON'T include causes or solutions (yet).

[2] Thomas Kayser, Building Team Power, CRM Films, Carlsbad, CA, 1994, pp 223 -226.

Have the group brainstorm for 'as is' conditions that might be viewed as problems. Brainstorming and simple voting tools can be helpful here. More elaborate methodologies like AHP with criteria (objectives) such as control, importance, difficulty, time, return on investment, resources can be useful to prioritize the as is conditions.

Step 2) Analyzing the problem. Identify, collect, and analyze data to confirm the problem is real. Identify and prioritize possible causes for what exists. The use of fishbone diagrams and AHP models can be helpful.

Step 3) Generating potential solutions. This can be done many ways, including brainstorming, research (secondary and/or primary), and design activities. What "should be", expressed as objectives, should guide the generation of potential solutions. Creativity is important in this step. Never stop with only one solution – two or hopefully more potential solutions should be generated.

Step 4) Selecting and planning the solution. Deciding which solution to select should be based on the achievement of objectives. The use of AHP will be instrumental in this step.

Step 5) Implementing the solution. This step often leads to an embedded decision process—generating potential ways to implement the solution and selecting an implementation alternative based on the achievement of objectives.

Step 6) Evaluating the solution. Was the problem 'solved'? If so, was the problem solving process effective? If the problem was not solved, was it due to a deficiency in the problem solving process or to the occurrence of an unforeseen event? In retrospect, was the unforeseen event unlikely to have happened or should it have been considered in the problem solving process?

Decision Making

Decision-making, the focus of this book, is a part of almost all human endeavors. While most decisions are connected with problem solving, many are not. Managers may decide to take actions that will set entirely new standards of performance or decide to attain some new goal or establish a new direction for their companies[3]. We will see that most managerial activities such as problem solving, strategic planning, and resource allocation, involve one or more components of what we will now define as the decision-making process.

Intelligence, Design, Choice

We will follow what is perhaps the most widely accepted categorization of the decision-making process first introduced by Herbert Simon[4]. Simon's categorization of the decision-making process consists of three *phases*:

- Intelligence,
- Design, and
- Choice

The INTELLIGENCE phase involves the identification of the problem or opportunity.

The intelligence phase – identifying problems or opportunities – can involve a wide variety of activities, such as listening to people (your customers, competitors, employees, suppliers, etc.); environmental scanning and the query of internal or external data bases, either intermittently or continuously; brainstorming for gaps between current conditions (as is) and some future conditions (what should be); or performing an analysis of your organization's strengths, weaknesses, opportunities, and threats (SWOT). Operationally, it will make no difference whether you view something as a problem or an opportunity – what some people view as a problem; others might view as an opportunity. What some may view as a headache, others

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[3] C. H. Kepner and B. B. Tregoe, B.B. The Rational Manager: A Systematic Approach to Problem Solving and Decision Making, McGraw Hill, New York, NY, 1965.

[4] Herbert A Simon, The New Science of Management Decision, (New York: Harper and Brothers, 1960), pp. 40-43.

may view as an opportunity to close the gap between what should be and what is. Vigilant executives identify many more problems/opportunities than they have time or resources to address and will have to address the 'meta' problem of deciding which problems/opportunities to address first.

It is often helpful to provide a succinct problem statement including: what are the primary symptoms of the problem; who in the organization has "ownership" of the problem? (or from whose perspective is the decision being made; are there any related problems that should be considered before, concurrently, or subsequently?) The cause(s) of the problem and alternative solutions should not be specified – these are addressed in the Design phase.

DESIGN refers to the design or identification of alternative solutions to the problem or opportunity.

There are numerous ways to generate alternative solutions (courses of action) including:

- Brainstorming
- Reviewing the literature
- Conducting research
- Benchmarking both within your industry and across industries
- Issuing a request for proposals for alternative solutions

Brainstorming, perhaps the most common method, will be discussed in more detail later.

CHOICE entails the selection of one (or a combination) of alternatives.

The choice phase is what most people think of as making a decision, e.g., they must make a decision between two contestants[5]. Choosing the 'best' one, or combination of alternatives is perhaps the most intellectually difficult part of the decision-making process. Until recently, choice was almost always made by intuitively trying to synthesize the pros and cons of the alternatives under consideration. The Analytic Hierarchy Process

[5] Random House Dictionary of the English Language, 2nd Edition, Unabridged

changed all that. We will see how AHP can help individuals and groups systematically identify the 'best' one or combination of alternatives.

What is 'Best'?

What do we mean by the 'best' choice? Suppose we were choosing a car from a dozen or so alternatives and all we were concerned with was the cost. The 'best' choice would be the car with the lowest cost. Simple. Suppose, instead, all we were interested in was acceleration. We could check the specifications of each of the alternative cars and easily say which is 'best'. Simple. (Conversely, a design engineer for one of the cars may have found the 'optimal' engine horsepower/weight ratio so that the car's acceleration was 'maximized'.) But life is *never* this simple when it comes to important decisions.[6] We may find that one car accelerates fastest from 0 to 60 mph but another accelerates fastest from 0 to 90. Which then is 'best'? In addition to wanting a low cost, suppose we also want a car with plenty of leg room, luggage space, that handles well, absorbs road shocks well, and is stylish. Which of several alternative cars is 'best'? There is no simple answer. In fact, the answer depends on our objectives.

Our operational definition of 'best' choice, or 'rational' choice is:

A rational or best choice is that choice that 'best meets the objectives'[7]

There are three important things about this important definition. First, there are numerous other definitions of rational, irrational, non-rational used in the literature, not all of which are, in our opinion, useful in making important, complex decisions. Second, note that we refer to the plural of objective, objectives. We claim that every *important* decision involves more than one objective.[8] Thus, all important decisions will be complex in the sense that there will be multiple objectives. Third, we have found that

[6] Remember, this book is only concerned with important decisions.
[7] Hence the title of this book: Decision by Objectives.
[8] We have asked hundreds of decision - makers for an example of an important decision with only one objective and have never been able to find one!

by focusing on *objectives*, rather than attributes or criteria[9], we can avoid ambiguities that might otherwise arise. For example, in choosing among alternative cars, a large car is typically safer, more comfortable, may not handle as well, and is less efficient in terms of fuel consumption. If, in making a choice between a large and small car, we consider the *attribute* 'size' of the car, or use 'size' as a *criterion*, we run into difficulties when trying to assess whether the large car is more preferable than the small car since size has both pros and cons. If, instead of considering size as an attribute or criterion, we focus on our objectives, we can say that, with respect to safety, the large car is more preferable. With respect to comfort, the large car is more preferable. With respect to handling, the small car is more comfortable. With respect to fuel consumption, the small car is more preferable. Of course, we will need a scale on which to measure and combine these preferences. This is provided by the Analytic Hierarchy Process, as we will see soon.

Decision-making is a Process

What is a process? As noted above, a process is a series of actions, changes, or functions that bring about an end or result. Let us illustrate with a process that almost everyone goes through daily – shampooing one's hair. The steps on the back of most shampoo bottles typically read as follows:

(1) Wet hair; (2) Apply; (3) Lather; (4) Rinse; (5) Repeat.

If one followed these directions literally he or she would never finish. But we all seem to make it out of the shower without too much difficulty. Somehow we know when our hair is clean enough. For some of us it may have been only one application, for some others two applications, and perhaps three or more for others.

[9] The literature refers to multi-criteria decision making, multi-attribute decision making, and multi - objective decision-making almost synonymously.

> A process also connotes a course or passage of time – an ongoing movement[10].

Decision-making is a process (not an event), which evolves over time, and almost always involves iteration. For example, after establishing a problem statement during the intelligence phase, one may, during the design phase or choice phase, discover that the problem should be modified or that a completely different problem or opportunity needs to be addressed. By thinking about the decision process in terms of these three phases[11] you will have a better understanding of the real world complexities that come into play in your decision-making.

Analysis vs. Synthesis

Most organizations have top level managers, mid level managers, supervisory managers, technicians and other experts, each capable of doing an *analysis* on one or more facets of a complex decision. However, as discussed above, few organizations know how to perform a *synthesis* of these analyses. In order for an organization to make a rational decision—that is a decision that best achieves the multitude of their objectives, they *must* be able to synthesize.

Quantitative vs. Qualitative

All decisions involve both quantitative and qualitative factors such as cost, performance, employee morale, and customer satisfaction. The following summary of a decision at a United States government agency is not atypical. After identifying the need for a new information system (the intelligence phase), a thorough study was performed to identify the requirements for the system. The requirements included both quantitative and qualitative factors. After alternative solutions were identified (the

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[10]The American Heritage Dictionary and Roget's II Electronic Thesaurus, 1987, Houghton Mifflin Company

[11]Other authors have expanded on Simon's three phase process, adding activities such as data collection, data analysis, implementation, and post implementation evaluation. We prefer to use Simon's model in our framework and fit other activities around this framework.

design phase), a benefit-cost analysis[12] was conducted. The group that performed the analysis reported their results in the form of benefit/cost ratios. They were satisfied with their study, and were careful to point out in their report that the benefit-cost analysis included only those factors that could be quantified. (Qualitative factors tend to get relegated to footnotes.)

The decision-makers were left in a quandary. They understood that the benefit-cost analysis included only the quantitative factors, but knew instinctively that the "best" alternative according to the benefit-cost analysis was not the best for their purposes. The discrepancy arose because the qualitative considerations could not be included in the study and the decision-makers did not know how to synthesize their qualitative considerations with the quantitative benefit-cost analysis.

You have probably been involved in a decision where the numbers told you to do one thing but your intuition told you something else. As an individual you have the luxury to dismiss the numbers and "go with your intuition."[13] A corporate decision-making group or a U.S. Government agency cannot do this. What can they do?

One thing they can do is to "re-evaluate" the quantitative factors, collect more data, and hopefully find a way to have the quantitative results coincide with their intuition. Some may view this as cheating. It is not! Quantitative factors are not the only considerations. Qualitative factors may be just as important, or even more important than the quantitative factors. Decision-makers would be shirking their responsibility by deciding on the basis of the quantitative factors alone.

The other alternative is to dismiss the benefit-cost analysis and start all over again. The frustration at having to do this stems from the lack of ability to synthesize quantitative and qualitative factors.

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[12]Benefit-Cost analysis is becoming a more popular expression than Cost-Benefit analysis. A tongue in cheek reason for the change in terminology is that it is impossible to divide by zero.

[13]There are also times when our intuition is wrong. T.L. Saaty gives the following example. Suppose we were to wrap a string snugly around the earth. The string would be about 25,000 miles long. Now suppose we cut the string and spliced in a ten-foot section and raised the string an equal distance above the earth all around its circumference. Would there be enough room for a mouse to crawl under the string? Most people's intuition would say no. A numerical calculation would tell you that not only would there be enough space for a mouse to crawl under the string anywhere around the circumference, but the string would be about 19 inches off the ground, enabling you to crawl under as well.

Many decision-makers resist having to conduct benefit-cost analyses. They argue that the time and expense of a benefit-cost study is not justified. This is only true for relatively small decisions. A second reason is that they view the study as necessary for satisfying some other department's purpose, but not really helpful in making the decision. Still another reason for such resistance is the hidden fear that the study may result in the quantitative supremacy of an alternative that the decision-makers "do not like." They (somewhat justifiably) view the benefit-cost analysis as a number crunching roulette wheel (sophisticated with present value calculations and the like) that could put them in an uncomfortable position. Consequently decision-makers turn their backs on benefit-cost analysis and attempt to make decisions using an intuitive synthesis of non-discounted costs and qualitative considerations. This fear would vanish if decision-makers had the ability to synthesize the quantitative benefit-cost analysis *with* their qualitative considerations. They would be able to capitalize on both the information generated by the benefit-cost analysis, and their knowledge and experience about the qualitative considerations. Thus, the ability to synthesize quantitative and qualitative factors in a decision is extremely important. We will see how this can be done shortly.

Objectivity vs. Subjectivity

Organizations like to think they make 'objective' decisions. Did you ever hear an executive tell someone "I'd like you to study this issue and give me a *subjective* recommendation?" Of course not. We use the word objective as if it meant correct. We claim that there are no objective crucial decisions! The proof is simple. As noted earlier, we have found that all important or crucial decisions have more than one objective. Economists like to think of measuring everything in dollars or dollar equivalents to try to force things into one dimension, but in practice, that doesn't work very well. The next time you are tempted to think of a decision on the basis of just one objective, say dollars, ask yourself, does time matter? What if you choose a low cost alternative but the time to implement is rather long? Does quality matter? Does public opinion matter?

In a decision with more than one objective, the relative importance of the objectives will influence the choice of the best alternative. Since every important decision has more than one objective, and since the relative importance of the objectives is *subjective,* every important decision is *subjective!* While this might at first seem contrary to what we were taught to believe, it is not inconsistent with other popular beliefs. Most people agree that *values* are subjective. What we are saying here is that all important decisions are influenced by our values (determining the relative importance of the objectives) and hence are subjective. Furthermore, many organizations recognize that hiring top quality people is important in being competitive. When we hire good people and pay them good salaries, why in the world would we ask them to make a decision or recommendation that is 'objective'? Wouldn't we want to capitalize on their 'subjectivity'?

Thomas Saaty, creator of the Analytic Hierarchy Process claims, (only half tongue in cheek), that objectivity is nothing more than agreed upon subjectivity!

Linear versus Non-Linear

Another aspect of decision-making that is often overlooked is the need to take into account non-linearities. Instead of a mathematical definition or example, consider the following situation. A hungry teenager goes to the Pizza shop for lunch. The first slice of pizza tastes great. The second slice tastes almost as good as the first, but not quite. The third slice is not nearly as good tasting as the second. Even for a hungry teenager, there comes a point when additional slices or pizza have no utility.

Two dollars, to most people, can buy twice what one dollar can, four dollars can buy twice what two dollars can, and so the 'utility' curve for money is linear when we consider small amounts. But what happens when we consider 2 million dollars versus 1 million dollars? Or 2 billion dollars compared to 1 billion? Eventually, the utility curve becomes non-linear. Even the U.S. Government would most likely have a non-linear utility curve at dollar values in the tens of trillions!

There is a tendency, when making decisions, to put too much emphasis on 'hard data'. Data, from a scientific instrument, for example, may have

been costly to obtain and is ‘objective’, so why ‘corrupt’ it with human judgment? This is generally short-sighted and should be avoided.

We have defined a rational decision as one that best meets our objectives. In the process of evaluating alternatives to see which is best, we will have to consider the utility (we will call it preference) of each alternative relative to each of our objectives. In general, these utilities will be non-linear and whatever methodology we use must take this into account. Note, that this is yet another reason why important decisions are always subjective—the utility of an alternative with respect to a given objective is often (perhaps always?) subjective!