Individual

Problem Solving

and

Decision Making

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Human Resources Development

Problem Solving and Decision Making

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Problem Solving and Decision Making

Introduction

Regardless of how well an organization has analyzed its situation and formulated goals and plans, interim and ad hoc problem-solving situations will arise between planning processes. Fortunately, problem-solving and decision-making technologies and tools have evolved over the years (Leidner & Elam, 1993). Today they help improve problem-solving practices and the outcomes from resulting decisions (Tasa & White, 2005). This booklet deals with methods, tools and practices that can help managers, leaders, and their subordinates compensate for mental limitations, leverage capabilities, and thereby improve their individual, unit and organizational problem-solving and decision-making processes.

"The Basic Concepts and Practices" section describes types of problem-solving situations, approaches to problem solving that are less effective than the analytic approach, and phases and steps involved in the analytic approach (analyzing the situation, formulating alternative solutions, and choosing among the alternatives).

Next, the "Developing the Problem Solver and Decision Maker" section describes problem-solving orientations and styles and additional ways to improve problem-solving effectiveness.

These pages are aimed at helping the reader do the following:

- Better identify and understand the variables that are influencing the effectiveness of his or her thought processes.
- Apply a method for more effectively structuring thinking situations in order to compensate for mental and environmental limitations.
- Better develop his or her own problem-solving and decision-making practices and skills, so that their use becomes second nature.
- Better improve or further develop subordinates' problem-solving and decision-making practices and skills.
- More effectively participate in contributing to organization-wide development and reinforcement of problem-solving and decision-making policies, practices, and procedures.

Basic Concepts and Practices

As discussed in an earlier segment on the analysis phase of the managerial process, problem situations almost always involve a number of causes, not just one single cause. Nonetheless, people do not generally think in terms of "multi-causality," so they usually say, "The problem is ____" and cite one single cause. However, there is no such thing as *the* problem. Instead there is a "problem situation" involving a number of causes. Therefore, here the term "problem situation" will be used in order to encourage readers to quit saying "the problem" and think more often in terms of multi-causality.

Types of Problem-Solving Situations

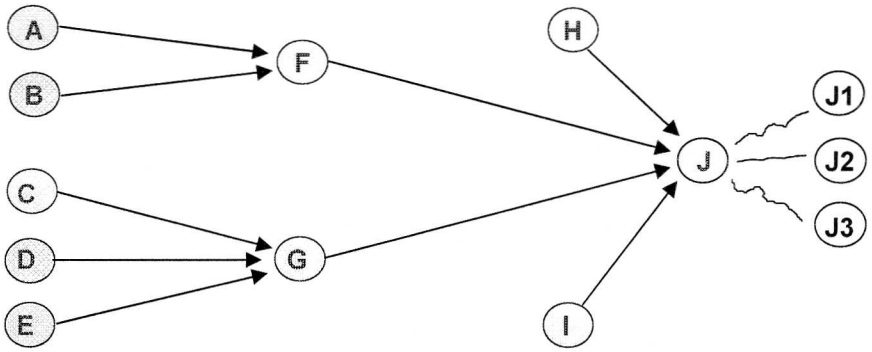
Problem situations can be placed into one of these four categories: (a) corrective (but also preventive of another occurrence); (b) preventive; (c) creative/innovative; and (d) improvement- oriented.

Corrective-Preventive: Probably the most common type of problem solving in organizations, this deals with problems that have already occurred and have just been recognized. Something that was neither intended nor expected has happened and there is a "fire to fight." As shown in **Figure 1** on the next page, such situations generally call for two sets of solutions. The first set is aimed at "putting out the fire" and *remedying the consequences* (negative effects or symptoms such as J1, J2, and J3 in Figure 1). The second set of solutions should be aimed at *preventing* the same situation from recurring (perhaps by correcting or improving underlying causal factors A though I in Figure 1). However, since formulating two sets of solutions can consume more time and effort, many people simply "use a band-aid" and perform remedial problem solving without going on to the preventive phase. This often results in (a) continually fighting the same fires, and (b) fighting other fires that are started by them.

Preventive: This type is aimed at keeping a problem situation from developing and occuring at all. Prevention first requires analyzing a situation in some depth and then identifying those factors (elements, activities, variables) that tend to exert the most significant desirable *and* undesirable influences on the situation. Once the major influ-

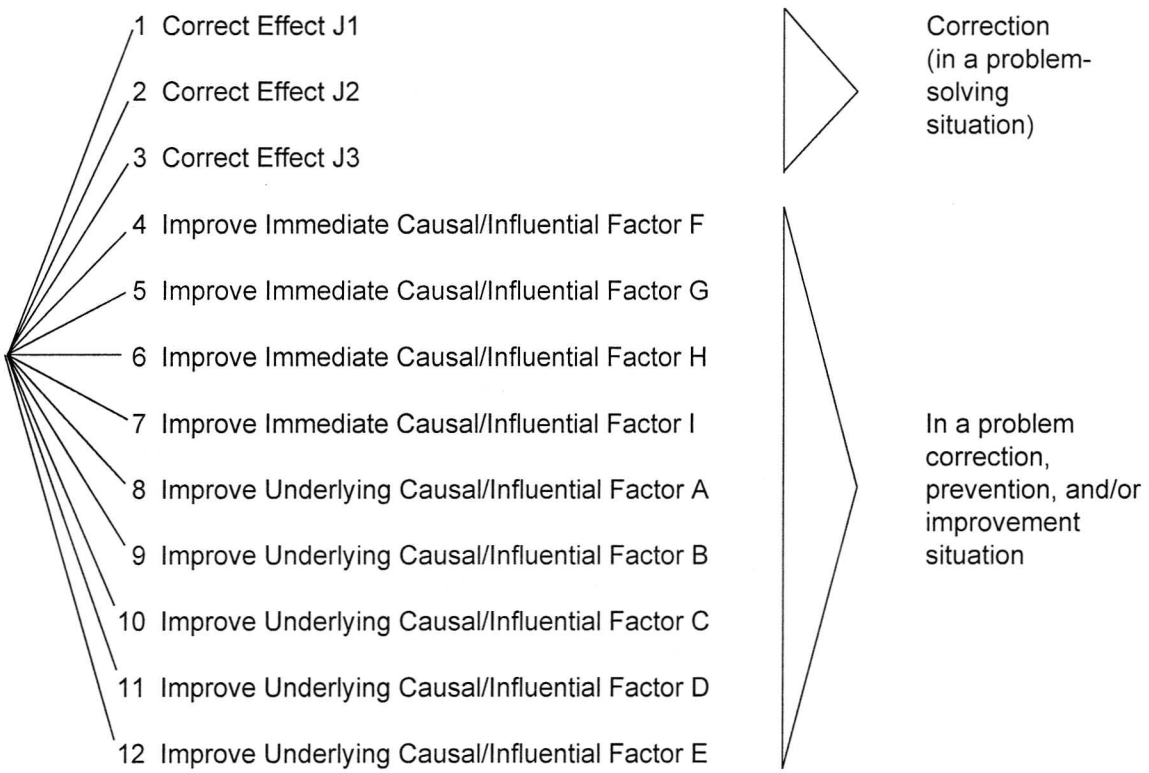
Figure 1: Example of a Multiple Choice Decision in a Problem-Solving, Problem Prevention, or Improvement Situation

Chain of causes and effects involved in a (simplified) Problem Situation



Real, Underlying Causal Factors | **Immediate, Superficial Causes** | **Symptomatic Effects**

Act Fork indicating various non-exclusive alternative courses of action for solving and/or preventing a problem or improving a situation



ences have been determined, the next step is to anticipate problem situations by looking for trends in those factors that could eventually lead to problems. Preventing problem situations then becomes a matter of changing, modifying, or otherwise influencing key factors so that they exert their influences in a more desirable manner. Preventive problem solving should be maximized during goal-setting and planning processes.

Creative/Innovative: Often called "brainstorming," creative thought first involves *describing* the characteristics and/or uses of known or familiar objects, activities, ideas, concepts, or theories. It then involves *comparing or relating* their characteristics, aspects, and/or uses. By finding previously unrecognized relationships between things, activities, and/or ideas, one arrives at fresh insights and ideas. "Innovative thought," however, is not the same as "innovation," which also involves moving something from the drawing board to general acceptance, availability, and use. This requires further analysis, planning, decision making, and action.

Improvement-Oriented: This type of problem solving revolves around developing new or improved products, concepts, methods, processes procedures, tools, and applications. It involves several problem-solving steps: The first is analyzing the object, activity, process, idea, or situation that one wishes to improve. The second involves identifying the elements or parts of the whole (that is, the associated parts or characteristics of the object; the sub-activities involved in the main activity; the elements or steps in the process; the elements of the idea; or the important factors/ variables involved in and/or operating on the situation). The third step is identifying those parts, elements, factors, or variables that could actually be improved. Improving the "parts" will bring about improvement in the "whole." Actually improving the parts generally requires further analysis, a certain amount of planning and decision making, and subsequent action. In our view at least, the bane of innovation and effective modern management is the old addages, "If it ain't broke, don't fix it.." There are very few variables operating in organizations that cannot stand some improvement. And without people seeking to improve things, there would be few innovations for improving our lives.

These four types of problem situations are related to each other in various ways. Prevention can involve creativity, innovation, and improvement. Innovation can stem from a need to improve or correct something. Correction may require innovation and improvement as well as prevention. It becomes evident, then, that *the type of problem-solving approach being used is largely dependent upon the problem solver's objectives in a particular situation*.

Thus, it can be concluded that both individuals and organizations could save tremendous amounts of time, effort, and money by recalling that "an ounce of prevention is worth a pound of cure" and then incorporating preventive, creative/innovative, and improvemental problem-solving activities into their planning processes.

Approaches to Problem-Solving That Are Less Effective Than the Analytic Approach

For many reasons, human beings generally do not think as well as we have the potential to think:

- Life and situations are extremely complex, which makes thinking rather hard work. Because our minds have difficulty handling complicated problems internally (on their own), most people would rather think about things that require superficial rather than deep thought.
- Many other activities and problems compete for our attention.
- Many people are more action-oriented than thought-oriented.
- Most people fail to use the methods and tools that would help them better handle difficult problem situations.
- We also tend to conserve time and psychic energy by using just enough to get by.

These are just some of the reasons that many have referred to us as the "mindless society." Several phenomena occur as a result of mental constraints that limit our thinking effectiveness.

Using past experience: Rather than fully thinking out a problem situation or decision, we often respond by relying on a solution that seemed to work well in a previous, somewhat similar situation. Unfortunately, these "programmed" solutions or decisions may not be fully effective in the present situation.

Cutting through the detail: Even if learned responses are considered inadequate, we still consciously and unconsciously reduce the proportions of a situation to manageable basics that we believe to be most important. For example, many managers believe they are smart enough to "cut through the detail and zero in on the real causes" without doing much of an analysis. Other people, who may cut through the detail because they only know a few possi-

Table 1: Problem-Solving Phases and Steps

A C T I O N	B E N E F I C I A L E F F E C T S
Phase I: Preparation	
Step 1: **Awareness** ⟶ **think what you're doing** (awareness based on brain's comparison of actual with planned or intended stimuli)	Consciously structure process and channel thought.
Step 2: **Describe** situation -- i.e., the unintended or unexpected events or effects that signalled the problem situation	Initial conscious recognition of problem situation; perform a more effective analysis
Step 3: Increase **motivation**: Determine importance in terms of personal and organizational goals and plans	Focus attention; increase concentration; initiate and sustain effort; take necessary time.
Step 4: Seek a conducive **environment**	Minimize distractions and interruptions.
Step 5: Get **organized** (materials, references, etc.)	Minimize distractions; be better organized.
Step 6: **Preview**: do a brief preliminary analysis	Determine real importance and priority of situation; budget time/money, more effort; be better organized.
Phase II: Analyze -- Define and Reduce the Problem Situation	
Step 7: Do an initial **qualitative analysis**. Identify system of possibly causal variables involved and the relationships among them (not just a single cause)	Increase repertoire of knowledge; help minimize influence of dysfunctional attitudes; *multi-causality*; keep from immediately jumping to solutions phase.
* use checklists to augment knowledge of factors	Help minimize effects of dysfunctional attitudes.
* diagram/model variables and their relationships	Enable mind to handle complexity.
Step 8: Collect important **facts** (associated with factors)	Increase repertoire; use objective (factual) inputs to thought; increase objectivity.
* use facts and observations (rather than opinions); use "working assumptions" as necessary	
* add facts or data to situation model	Enable mind to handle complexity; elicit continuing use of the analytic approach.
Step 9: **Analyze** information and identify the real, underlying, multiple causes (in chains of causes and effects)	True "problem identification."
Step 10: Formulate **criteria** for Phase IV (Decision Making)	Improve testing/weighing of alternative solutions.
Phase III: Plan -- Alternatives (Solutions) Formulation	
Step 11: Formulate **goal(s)/objective(s)**: identify the desired end results of implementing solution(s)	Assures going in right direction(s) toward some consciously identified target(s).
Step 12: **Plan**: Identify what must DO to improve, change, Correct, or adjust variables and their relationships	System of solutions for system of causes (in cause-effect sequences); fix situation and prevent future occurrence.
- Formulate alternative sets of strategies/tactics	
- Formulate alternative sets of courses of action	
- Budget time and resources	Effective use of time and resources.
* use appropriate diagrams	Enable mind to handle complexity.
Phase IV: Decision Making -- Test and Select Alternatives	
Step 13: Identify possible **outcomes** of alternative solutions (anticipate scenarios/sequences of actions and events)	Anticipate what could occur during implementation. Increase use of propositional ("what if") logic.
Step 14: Assess realistic **probabilites** of possible events	Minimize wishful thinking about what might occur.
Step 15: **Test and compare** alternatives	Mental trial and error (action in rehearsal);
- Identify and compare advantages & disadvantages	inputs to making final decision.
- Weigh each alternative against Dec-Making criteria	
- Also test/weigh combinations of alternatives	
* use appropriate diagrams	Enable mind to handle complexity.
Step 16: **Select** appropriate solution(s) for implementation	Final decision-making.
Phase V: Implement Chosen Solution(s)	
Step 17: As implement, monitor and evaluate feedback	Check on progress; assure getting desired results.
Step 18: Adjust plans or behavior	Effective response to obstacles and contingencies.

bly causal variables, tend to use the "common sense," "simplistic," or "simple-minded" approach. In either case, when we solve problems and make decisions based on only a few seemingly important variables and corresponding facts, we can (a) overlook the real, underlying causes of more obvious causes, (b) overlook factors and facts that together could be more important than those we are considering, (c) be hampered by negative attitudes toward thought, (d) be hurried by expediency rather than rationality and objectivity, and (e) use an inferior approach.

Trial and success method: Another way to avoid in-depth thinking is to use the method previously called "trial and error." It involves either (a) attempting various known possible solutions until one finally works, and/or (b) formulating possible solutions and trying them until one works.

The above is not meant to assert that the more simplistic approaches have no place in problem-solving situations. Even so, their use is more justifiable in situations where (a) immediate action is required, but too little time is available for more in-depth thought; (b) necessary facts are either unknown or unattainable; (c) the situation must be resolved in one's head due to lack of aids such as paper and pencil, calculators, chalkboards, or flipcharts; or (d) the only way to determine whether a possible alternative will work is to try it. The point, however, is this: *The more simplistic approaches are used too often when the complexity and/or importance of problem-solving or decision-making situation warrant our usage of the much more powerful analytic approach.*

Phases and Steps of the Analytic Approach

Since the analytic approach to managerial planning was described in several previous segments of this series, we will not go into more detail about the managerial aspects here. We will, however, go into more detail regarding the phases and steps that should be taken in order to maximize an individual's problem-solving and decision-making effectiveness.

Table 1 outlines phases and steps of the analytic approach in the left column, and describes the beneficial effects in the right column. Although the table is fairly self-explanatory, several points deserve some elaboration.

Phase I: Preparation

Step 1 – Be aware and stop to think what you are doing and how to do it well: Even though the analytic approach is the most powerful for structuring problem-solving and decision-making processes, and even though the concepts and steps involved enable us to minimize or compensate for many mental limitations, managers must consciously think about what they are doing and then purposefully use the principles and steps they have learned in order to do it well. The question is, will individuals stop to think about such things, or will they simply slip unconsciously into using past responses to similar situations? Human beings are generally inclined to do the latter—unless we recognize that the present situation is an obvious exception to the "fog of everyday problems" and it actually dawns on us that we are in a problem-solving situation worth extra conscious thought. *Undesired, unintended or unexpected stimuli* (events or phenomena) are the "triggers" or "signals" for creating that awareness. They prompt us to say to ourselves, "I am in an important thinking situation and will consciously apply what I have learned about the analytic approach in an effort to use my mind more effectively."

Step 2 – Describe the situation: In order to develop some sense of the nature and proportions of the situation, describe the unintended or unexpected phenomena which signalled that a problem situation has occurred. For example, exactly what did one person say or do that resulted in an interpersonal conflict? What exactly is wrong with an improperly manufactured part? What has occurred that you did not intend to occur? The important point here is this: if we incorrectly describe what has happened, we can end up looking for the wrong causes.

Step 3 – Increase motivation: Motivation is one of the greatest influences on how well we do anything. The intensity of personal motivation is a function of the levels of our needs or drives, values, interests, goals, and expectations. Increasing our motivation helps us better focus attention, increase concentration in the face of distractions, sustain effort, and more conscientiously apply problem-solving and decision-making methods. To increase one's own personal motivation, consider how resolving the situation successfully will increase the attainment of personal and organizational goals. Also, imagine how it will feel to attain those goals.

Step 4 – Seek a conducive environment: Limit the interruptions, noises, and other distracting stimuli that can disrupt one's concentration and "train of thought."

Step 5 – Get organized: Also limit interruptions and distractions by gathering together any necessary information, materials, or equipment. Minimize "people problems" by planning and organizing interactions with those who should take part in the process.

Step 6 – Do a brief preliminary analysis (preview): At first glance, many if not most problem situations can seem simpler and less important than they actually are. It generally takes a preview analysis to determine (a) just how complex and important the present situation is, (b) its priorities relative to other situations, and (c) how much time, money, and effort might be required by the problem-solving process. Previewing usually increases personal motivation as well.

It may not always be possible to perform Steps 2 and 5 in the above order. Nevertheless, one should keep in mind that environmental, motivational, and organizational factors can all influence how effectively one handles a problem situation. The important point: the time to control these influences as much as possible is before beginning the analytic approach, because they can each influence whether or not one uses the analytic approach at all.

Phase II: Fully Analyze the Situation (Define and Reduce the Problem Situation)

Step 7 – Perform an initial *qualitative analysis*: Effects or events occur because variables such as people, objects, forces, or phenomena have been operating in the environment and causing those events. Solving a problem requires determining the factors that actually caused problematic effects. In most situations, there are many factors that *could* have been involved in some manner or to some degree. Discovering which of these were the *actual causes* first requires identifying *all the possibly significant variables* that could be involved. However, since factors are often interrelated and interdependent, one must also consider the interactions among them.

In order to consider possibly important variables that you might not already know, use *checklists* of factors and any other sources of such information. This increases your existing repertoire of knowledge and helps you "think outside the box." In fact, it usually helps one think about variables in a "number of boxes."

In order to handle details about factors and their interrelationships visually, use *models or diagrams*. These tools make many bits of information visible at one time, thereby (a) enabling the mind to "juggle" them all more easily, and (b) freeing it to analyze, evaluate, relate, and develop deeper insights into the situation. Writing information on diagrams or models also records the information better in memory. (Neurophysiologists (Eccles, 1960; Eccles & Robinson, 1984) have reported that the brain does not record well what we think, say, or periods of skilled activity.) Furthermore, since *problem solving is a major mode of learning*, diagramming variables and their relationships also expands the amount of accumulated knowledge that one will have available for future problem-solving and decision-making situations.

Diagramming and modelling also yield these benefits: As we write down and model the system of potentially causal variables, additional factors and their relationships tend to occur to us. Diagramming also helps us keep factors, their relationships, and our own thoughts, insights, and ideas organized. Perhaps the greatest benefit lies in the fact that modelling elicits our continued use of the analytic approach. As we write down factors and their interrelationships, we automatically begin to formulate solutions and think about whether or not they could work successfully.

Step 8 – Collect important facts or data: Once having identified factors for further consideration, you can proceed to determine what to find out about them and then gather the corresponding facts or data. When collecting the important facts, you should ask the following questions: Are the "facts" being collected actually facts, or are they someone else's opinions, assumptions, or conclusions? Are the sources reliable and credible? How could the "facts" be colored by those sources' needs, values, attitudes, biases, knowledge, experiences, and personal goals? How and to what extent is my interpretation of the "facts" perhaps being colored or distorted by my own needs, values, interests, biases, goals, expectations, and limited knowledge and experience? With respect to any statistics being compiled, what assumptions might have been made regarding their compilation? How were they interpreted? Have they been presented in a manner designed to prove a particular point? Statistics and other people's assumptions, conclusions, and opinions can be very misleading.

Many times facts are unknown, unavailable, unverifiable, or uncertain. Therefore, it may be necessary to "fill in the blanks" (gaps in information) with "working assumptions." These assumptions should be based on known facts and actual experience to the extent possible. For example, one might deduce that, since X and Y are known to be true (it is true that person X and person Y in a three-person unit are both highly motivated), it is reasonable to conclude that Z is also true (it is probably true that person Z is also highly motivated)—and that, therefore, the conclusion about Z constitutes a viable "working assumption." However, having formulated such assumptions, you must constantly distinguish between them and the real facts. It can be very risky to base solutions or decisions on an analysis of important variables whose corresponding "facts" have only been assumed. Making too many assumptions can lead to faulty decisions.

Collecting important facts helps compensate for one's limited knowledge and experience. It is also an important learning process that expands one's repertoire of information for future use.

So as to better recall and use these facts, keep them organized, and mentally juggle them, write them down on the problem model next to (beside, above or below) the variables with which they are associated.

Step 9 – Analyze the situation's qualitative aspects and associated quantitative aspects to identify the system of multiple causes and effects requiring solutions: Once the facts or data have been gathered and connected with the appropriate variables and their relationships (on the model), the situation can be fully analyzed. As shown in Figure 1, you should determine the following: (a) which variables affected which variables and in what cause-effect sequences; (b) the symptomatic factors that require "repair"; (c) the immediate or obvious causes that require correction or improvement; and (d) the underlying causes that require correction or improvement.

Step 10 – Formulate criteria for testing and selecting alternative(s): Use the insights gained from the above analysis to identify the appropriate quantitative and qualitative criteria for testing and comparing alternative solutions (which will be formulated during the next phase). These criteria can define, for example, (a) factors that should remain unchanged, (b) performance parameters, (c) desired standards or benchmarks of performance, and (d) time, budgetary, and other limits that should be imposed on solutions.

Phase III: Formulate Alternative Solutions (Plan)

Step 11 – Formulate goals/objectives: Formulate the desired end results to be obtained through the implementation of solutions. For guidance regarding this step, see the section of the series on goal setting.

Step 12 – Plan what to do (strategies, tactics, and more detailed action plans): Once all the variables that should be changed, adjusted, or improved have been identified, this series of steps amounts to formulating the ways and means for bringing about the desired changes or improvements. Depending on the nature and importance of the situation, formulating alternative solutions can involve formulating alternative strategies, tactics, programs, projects, action plans, and budgets. However, any problem-solving situation should at least involve formulating alternative action plans. For guidance regarding this series of steps, see the segment of the series on Planning.

Because problem situations most often involve "systems of causal factors," there will almost certainly be more than one single solution. It will probably be appropriate to formulate a number of alternative solutions. The alternatives may be modified and/or combined in various ways so as to constitute an effective "system of solutions."

To help keep track of solutions and how they interrelate, continue using the analytic diagrams of factors and associated quantitative or qualitative information as appropriate. To help keep track of what should be done, in what order, by whom, and when, use the visual planning tools described in the segment on Planning.

Phase IV: Make Decisions—Test, Compare, and Select Alternatives for Implementation

Step 13 – Anticipate possible outcomes of implementing each alternative: Many problems are only solvable by trial and success (error). However, in many situations, trying a poor solution can create more problems than it solves. Why? Since a problem situation is a system of many variables, and since the variables are often interrelated or interdependent, changing, adjusting, or otherwise influencing one can also affect others. These indirect changes may not be desirable for a number of reasons. Because implementing solutions will cause subsequent events or effects, now is the time to predict and analyze the possible outcomes of various solutions—before any of them are actually implemented. In effect, you will be evaluating and testing the chain of causes and effects that might occur. What you plan to do will constitute "causative actions" ("acts"). What happens as a result will be the effects ("events"). The idea is to use trial and success mentally and/or on paper rather than immediately doing something that may adversely affect the system you are hoping to improve. As Sigmund Freud said, "Thought is action in rehearsal."

To handle details involving acts, possible events, and probabilities of possible events, utilize tabular tools such as comparison matrices and visual tools such as scenario diagrams and decision trees. (See the segment on decision making for guidance and examples.)

Step 14 – Assess realistic probabilities of possible events: When doing so, be as objective as possible. Be careful not to let wishful thinking taint assessed probabilities with your preferences. If, for example, you have a *preference* for a particular outcome or event, be careful not to let it *increase* your estimate of the probability that it will occur. If, on the other hand, you have an *aversion* to an outcome or event, be careful not to let it *decrease* your estimated probability. Record assessed probabilities on, for example, a payoff matrix or decision tree to help visualize the information.

Step 15 – Test and compare alternatives: As you test hypothesized solutions, there is yet another important point to keep in mind. Nothing is perfect. Everything has advan-

Table 2: Thinking (Problem-Solving) Orientations or Styles

	Verbally Oriented			Non-Verbally Oriented			
General skill orientations Gardner (1983, 1999):	Verbal / Linguistic	Intrapersonal	Interpersonal	Sensory-motor (Physical)	Visual/Spatial	Mechanical	Quantitative / Mathematical
Type of "smarts" used (Abram, 2003)	Word smart	Self smart	People smart	Body smart	Picture smart	Mechanically smart	Numbers smart
Mental capabilities involved							
Aspect of academic intelligence	Verbal						Mathematical
Social intelligence/insight			Social insight				
Spatial thinking					Spatial Thinking	Spatial thinking	
Mechanical intelligence						Mechanical intelligence	
Type of logic used							
Class / deductive logic	Class logic	Class logic	Class logic		Class logic	Class logic	Class logic
Propositional / inductive logic	Inductive logic		Inductive logic		Inductive logic	Inductive logic	Inductive logic
Info sources relies on	External info (reading mat'ls)	Internal feel-ings, thoughts	External sources	External sights Internal sensations	External sources	External sources	External info Internal thoughts
Senses use for info-gathering							
Visual (sight)			Observe	Observe	Observe		Observe
Read	Read						Read
Auditory (hearing)	Listen		Listen				Listen
Tactile (touch)		(Internal)	Touch				
Kinesthetic / motor feedback				Motor feedback			
Personality tendencies							
Active / Vigorous				Active/Vigorous			
Original thinking							
Concrete (tangible, observable)					Concrete	Concrete	
Conceptual (verbal concepts)	Conceptual; verbal						Abstract (Math / Science)
Abstract (math, symbolic)							
Thinking introvert/extrovert		Think'g introvrt	Think'g extrovrt				
Social introvert/extrovert		Social introvrt	Social extrovrt				

Table 3: Cognitive (Problem-Solving) Styles and Related Orientations

Cognitive style types **McKenny & Keen** (1974):	**Information-Gathering and Assimilation**			**Information Evaluation**		**Information Response**	
	Receptive ⟵	⟶ **Preceptive**		**Systematic**	**Intuitive**	**Active**	**Reflective**
	Tangible Orientation	**Verbal Orientation**	**Abstract Orientation**				
Basic description:	Focus on details; examine all data	Focus on concepts and relationships among variables (relational thinking)		Use methods; use sequence of logical steps	Go by intuition or "gut feel"; more subjective than objective	Are practical, impatient to act or experiment	Ponder situation and information before take action
Think about, or in Terms of: Tangibles (what see, touch)	Concrete info				Concrete info		
Methodologies				Applying methods			
Conceptual (concepts/ideas in verbal terms/constructs)		Verbal constructs					Verbal Constructs
Abstract (concepts/ideas in mathematical/symbolic terms)			Abstract constructs				
Feelings / attitudes					Feelings / attitudes		
Intellect and education levels Verbal constructs	Avg. intel/edu	Above avg. intel/edu	Above avg. intel/edu	Above avg.intel/edu	Above avg.intel/edu	Avg. intel/edu	Above avg.intel/edu
Abstract (math) constructs	Avg. intel/edu	Above avg. intel/edu	High intel/edu				
Problem-solving approach(es) Past experience	Past experience				Past experience Past Experience	Past experience	
Common ense (simplistic)	Common sense				Common sense	Common sense	
Trial and success/(error)	Trial & success					Trial & success	
Analytic approach		Analytic approach	Analytic approach	Analytic approach			Analytic approach
Major learning method used Whole-to-parts		Whole-to-parts	Whole-to-parts				
Parts-to-whole	Parts-to-whole						
Mediating (Whl-Prts-Whl)				Mediating (W-P-W)			Mediating (W-P-W)
Basic type of learner Concrete experiencer	Concrete experiencr					Concrete experncer	
Active experimenter						Active experimenter	
Verbal conceptualizer		Verbal conceptlizer					Verbal conceptlizer
Reflective observer							Reflective observer
Abstract conceptualizer		Abstrct concptualizr					Abstrct concptualizr
Most significant value(s) Practical-mindedness	Practical					Practical	
Intellectual/theoretical value		Intellectual value	Intellectual value				Intellectual value
Major personality trait(s) Original Thinking		Original thinking	Original thinking				Original thinking
Active / Vigorous						Active / Vigorous	
Orderliness				Orderly / Organized			
Emotionality					"Feelers"/"emoters"		
Where required		Gen'l management	Mathematics/science		Need creativity and idea generation	Need quick decisions & action	Complex situations; best decisions

tages and disadvantages. This also applies to hypothesized solutions. There is a natural tendency to overlook certain advantages and disadvantages because of our positive and negative attitudes toward particular solutions and their possible outcomes. Therefore, identify all the advantages and all the disadvantages. If you cannot find both, something can very well be wrong with your analysis. What you must decide is: Do the advantages outweigh the disadvantages? Use decision-making criteria to compare the pros and cons of all the (sets of) alternatives.

Step 16 – Choose appropriate solution(s) for implementation: As discussed earlier using **Figure 1**, solving problems most effectively often means choosing a system of solutions to deal with a system of causes. However, this can involve determining the following: (a) whether or not to use any particular solution independently of the others (by reviewing its advantages and disadvantages, its estimated probability of success, and its ability to meet or exceed decision-making criteria); (b) whether or not to modify or adjust any particular solution so that it will work more effectively; (c) whether or not to use combinations of alternative solutions; (d) whether or not implementing any one alternative might adversely affect the implementation of any other alternatives; and, given the previous answers, (e) whether or not using various possible combinations—and thereby affecting various factors in potentially positive *and* negative ways—will somehow cause solutions to work against each other and adversely impact final results. It takes the use of visual aids such as situation models, scenario diagrams, and decision trees to handle the complexity of the above analyses. However, we caution against the use of decision trees if one has not been properly trained in their use.

If specific solutions or certain combinations of solutions conflict, choose between them based on the following considerations: First, do the overall advantages of one outweigh the overall advantages of another? Second, which alternative(s) has/have the greatest probability of contributing to successful resolution of the problem situation? Third, which alternative(s) best meets/meet the selection criteria established in Phase II? Fourth, which alternative(s) best fits/fit into the overall system of solutions? After answering these questions, stand back from the trees and look again at the forest. Ask, "Does this system of solutions work together effectively to deal with important aspects of the situation?" Then ask, "Is this sytem of solutions compatible with organizational goals and plans?" If either answer is "No," further modification of alternatives may be advisable. If at some point the answers are both "Yes," you are ready to go on to Phase V (Implementing Solutions/Decisions). However, remember what Rachel K. Sobel (2001) reported: *Research shows that, even when people think they are making rational judgments, their emotions may actually be driving their choice of alternatives*.

Phase V: Implement Chosen Solutions

At this point, thinkers should shift gears and take action. On the other hand, action-oriented people should take action, but only if they have adequately thought things out first.

Step 17 – As you implement one or more solutions, monitor and evaluate results

Step 18 – Solve problems: If obstacles or problems are encountered during the implementation phase, do further problem solving and then implement adjustments or fresh solutions.

Developing the Problem Solver and Decision Maker

Problem-Solving Styles and Orientations

Problem-solving styles are often called "thinking" or "cognitive" styles. A number of experts have identified various styles, but categorize them in different terms. Unfortunately, because two of these frames of reference come from different angles or viewpoints, all the parameters could not be interrelated within a single matrix. Therefore, our discussion of styles requires two separate but somewhat related tables.

Table 2 focuses on a frame of reference suggested by Harvard psychologist Howard Gardner (1983, 1999). It identifies seven types of intelligence, which Stephen Abram (2003) calls "types of smarts." One important type of intelligence is missing from this typology: "machine smart" (mechanical intelligence, of which spatial intelligence is a part). Here it has been substituted for "music smart," because activities in most organizations involve mechanical matters rather than musical matters. The table also indicates various other characteristics that can be associated with the primary classifications: (a) the more scholarly terms for the mental capabilities involved; (c) the major sources of information on which one generally relies when thinking and learning—according to Malcom, Lutz, Gerken, & Hoeltke (1978); (d) the senses one primarily uses for gathering information; and (e) personality traits that are generally associated with some styles.

Table 3 primarily focuses on "cognitive styles" suggested by McKenny & Keen (1974) and further described by Whetten & Cameron (2005). Note that the "preceptive"

category has been divided into "verbal orientation" (for people who primarily relate verbal constructs) and "abstract orientation" (for people who primarily relate mathematical or scientific numbers and symbols). Also note the arrow which indicates that, in order to be able to relate verbal and abstract constructs, "preceptive information gatherers" initially had to learn (be receptive to) the more basic verbal and/or abstract information that underlie or make up the constructs. The matrix also indicates associated "types of learners," a frame of reference suggested by Kolb, Rubin, & McIntyre (1971, 1999). The table also indicates values and personality traits that the authors associate with the categories.

Factor-Related Ways to Improve Problem-Solving Effectivess

Although the analytic approach is powerful, simply using that approach is not enough if one wishes to maximize problem-solving and decision-making effectiveness. As discussed in the segments on managerial analysis and planning, other major elements influence how well we can solve problems and make decisions. To think most effectively and efficiently, some of these factors must be minimized, while others must be maximized.

The left side of **Figure 2** (page 12) lists the "advance or ongoing preparation" activities that will increase one's effectiveness in any subsequent problem-solving situation. The benefits of these activities are indicated by arrows pointing to the affected phases and phenomena on the right side.

Formulate Goals and Plans (to Elicit Conscious Awareness of Problem Situations)

In order for us to become consciously aware of an important problem situation and then stop to think about what we are doing and how to do it well, something must trigger that awareness.

For us to become aware of a problem situation, brain mechanisms that operate at subconscious levels must monitor the stream of environmental stimuli we are sensing and somehow select certain stimuli for our conscious attention. These mechanisms continually compare actual stimuli with any intended or expected stimuli—*if* those intended or expected stimuli have already been recorded somewhere in memory. If actual stimuli compare with intended or expected stimuli, we do not perceive that a problem situation exists. But if they do *not* compare, we somehow become consciously aware that we are in a problem situation. This phenomenon is the brain's version of "management by exception," where actual, resulting figures are compared with budgeted figures, and, if the two figures do not match, managers recognize that some sort of problem situation exists. The point is this: Without our having in mind any preferred, desired, intended, anticipated, or expected outcomes or events, it will seldom occur to us that we have any problems.

Therefore, a *major key* to more effective individual and organizational problem solving involves (1) *formulating personal and organizational goals and plans*, and then (2) *writing them down* so as to better record them in memory. By doing so, we (1) increase the likelihood that our subconscious mind will trigger conscious awareness that a problem situation exists, and also (2) increase the likelihood that we will actually stop to think about what we are doing and how to do it well. Furthermore, personal and organizational goal setting have the additional benefits shown in **Figure 2**: they help increase one's motivation during the preparation phase and they *increase one's motivation to improve in the ways described below*.

Make a Habit of Using the Analytic Approach

Almost everyone has learned the phases and steps of the analytic approach at some time. The question is, have we habituated both the tendency to use them when we should and the ability to use them properly. If we have not practiced them to the point that their use has become "second nature," we may not use them at all. In fact, we may keep using the bad habits we have developed, especially if we do not consciously think about using the proper phases and steps when it is important enough to do so. Two activities help habituate their use. First, formulate personal and organizational goals and plans in order to trigger your use of the approach in a greater number of important situations. Second, it may help if you remember this phrase:

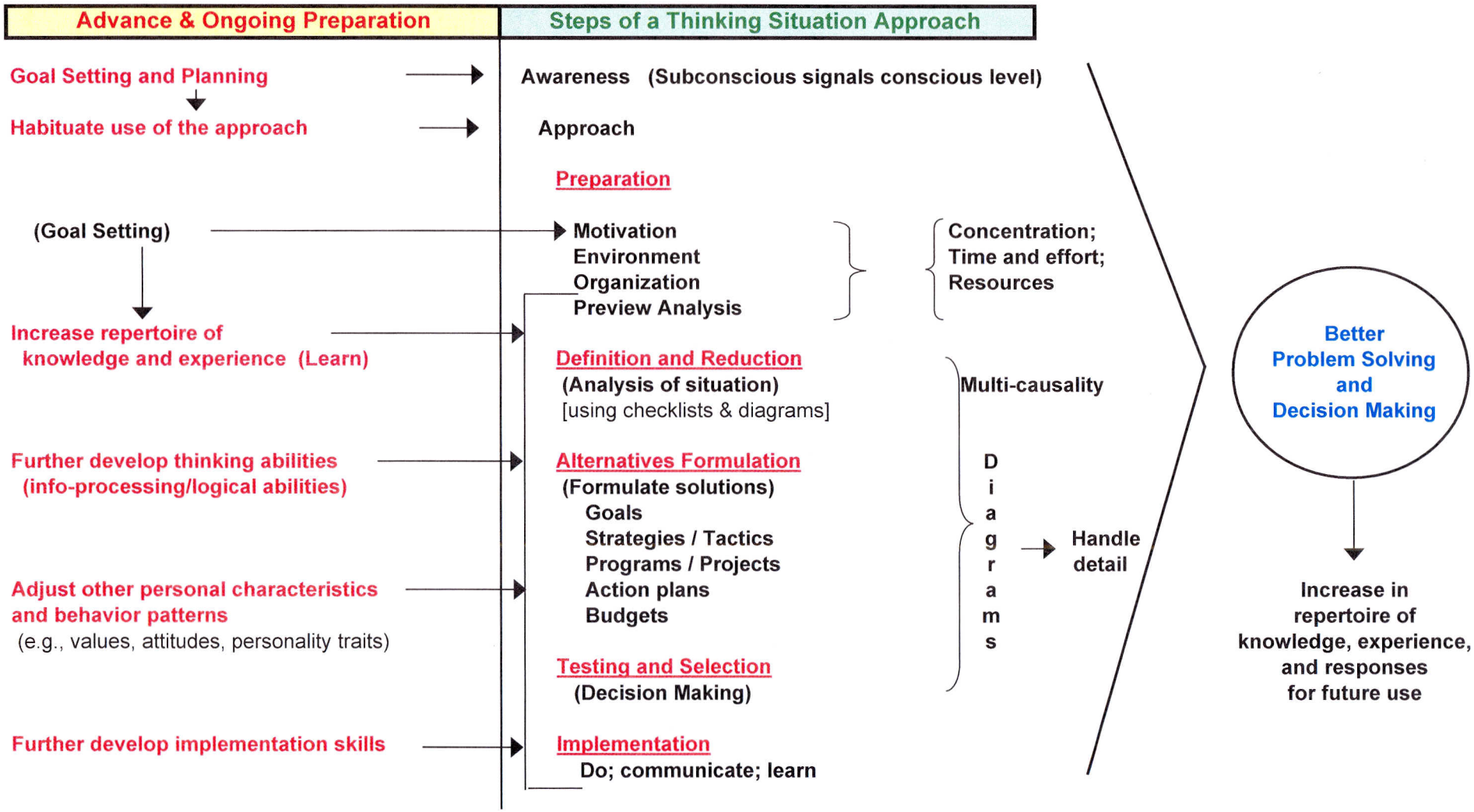
"PREPARE for DRAFTS and IMPLEMENT"

"Prepare" refers to the preparation steps; "DR" stands for define and reduce (analyze); "AF" stands for alternatives formulation; and "TS" stands for test and select; and "Implement" refers to the implementation phase. Associate it with the words "undesired," "unintended," and "unexpected," which can help jog awareness of problem situations.

Constantly Increase Your Repertoire of Knowledge and Experience (Learn)

We use our existing *knowledge* (information and experiences previously recorded in memory) to analyze problems and understand them in all their aspects. At any given moment, therefore, how much we already know par-

Figure 2: Advance/Ongoing Activities for Continually Improving Problem-Solving and Decision-Making Processes



tially determines how many potentially causal variables we are able to identify and how many corresponding facts we can use to analyze the situation (without having to collect more). Solving problems is largely a matter of using what we know. Hopefully it will be enough to enable us to better recognize what more we might need to find out (factors to consider and facts to collect). Unfortunately, everyone's knowledge of variables and facts is limited and "imperfect." This obviously limits our analytic, planning, and decision-making effectiveness.

Experience helps us answer questions such as: "What might happen if I/we do this or that?" and "What has worked before and what hasn't?" Therefore, experience is useful when (a) identifying cause-effect relationships among variables, (b) formulating possible solutions, (c) selecting one (or more) for implementation, and then (d) implementing plans or decisions. Here again we are limited. No one has all the experience necessary to solve a particular problem as well as it might be solved. Also, as mentioned earlier, past experience (previously used solutions) may or may not be appropriate for a new situation. What happened or what worked in a previous situation undoubtedly occurred within the context of a particular set of circumstances. Even though the two situations may be similar, there are always differences that can nullify the appropriateness of previous solutions.

Knowledge and experience can certainly be increased by reading, studying, watching, listening, and doing. However, we emphasize that knowledge and experience can be *maximized* over time by using *each* important problem-solving situation to do the following: (a) more fully analyze the situation by identifing and considering more potentially causal variables and their relationships; (b) collect more associated facts or data; (c) formulate more alternative solutions and possible combinations thereof; (d) identify more possible outcomes of alternative actions; (e) increase consideration of probabilities of possible events; and (f) identify and consider more advantages and disadvantages of alternatives. In other words, the more we consider, sort out, anticipate, weigh, diagram, and write down *each time*, the more that gets recorded in memory for use the next time. When are especially good times to do the above? During *personal and organizational planning processes*. The results of acting on these suggestions are cumulative—and perhaps even exponential.

Further Develop Thinking Abilities

Types of "Smarts": As suggested in **Tables 2 and 3**, how well we are able to analyze and solve many of life's problems is largely a function of our levels of academic intelligence and social intelligence (or social insight). In general, the more intelligent we are, the better our abilities to reason (juggle information back and forth between memory and reasoning areas of the brain). How well we can analyze and solve mechanical and spatial problems depends to a great extent on our levels of practical or mechanical intelligence and aptitude for spatial thinking (or mechnical visualization). Spatial thinking is thought to be a pure (inborn) ability and not subject to further development. Mechanical intelligence can be further developed by increasing knowledge of mechanical principles and by accumulating experience through applying the principles and working with mechanical objects. Verbal abilities associated with academic intelligence can be further developed by increasing one's vocabulary and dealing with verbal constructs. Mathematical aspects of academic intelligence can be further developed by taking math and science courses and by working on mathematical problems.

Developable Abilities: The following are examples of mental abilities involved in juggling visual, verbal, and other types of information back and forth between the brain's reasoning areas and its short- and long-term memory areas.

Class logic is the ability to (1) define or describe objects or activities in terms of various characteristics; (2) compare or contrast the objects or activities based on their characteristics; and (3) determine similarities and differences between the objects or activities. Class logic is most important during the analysis phase, but is also involved in the analytic aspects of formulating solutions and making decisions.

Deductive logic is related to class logic. Using deductive logic, one draws a conclusion—based on given or accepted general principles, statements/facts, or assumptions—that something (for example, a fact) must be true. Conclusions are certain because they are implied by the "givens" or assumptions. For example, given the premise that all monks are poor, and also given the premise that some Englishmen are monks, one "deduces" (concludes) that some Englishmen are poor. Notice that this conclusion was derived by putting these people into groups based on shared characteristics (a result of using class logic).

Propositional logic deals with things as they might or could be. In other words, it deals with the future and its uncertainty. Using propositional logic is a matter of asking "what might happen if _____." It is essentially a matter of mentally testing alternatives and their outcomes (based largely on past experience). For example, (1) "If A is true, and if B is true, then C either is or is not true"; (2) "Since I successfully used Solution X

many times to resolve customer complaint A (under circumstances X, Y, and Z), and this situation is exactly the same in all respects, then Solution X should probably resolve this customer complaint. But I'm still going to consider other solutions as well."

Inductive logic is related to propositional logic. It basically involves drawing a conclusion that something is or may be operating—such as a principle or a theory. In this case, the study and comparison of accepted facts leads to the derivation of a theory. Often, one is seeking to provide a true statement concerning all objects in a class by examining a sample of objects in that class. For example, "Given the fact that there's been a unit meeting every Tuesday so far this year, and given the fact that there has been no apparent reason for this policy to have been changed since last Tuesday, then one can conclude that there will be a meeting this coming Tuesday."

These abilities are seldom if ever fully developed in any of us. The more we work on further developing them, the better we will be able to solve problems and make decisions. Class logic and deductive logic can be further developed by (a) increasing one's vocabulary for defining and describing things, people, events, and so forth; (b) actually defining, describing, and categorizing things; and (c) analyzing complex situations. Propositional logic and inductive logic can be further developed by taking math and science courses. They can also be developed by constantly asking the following during planning and decision-making phases: "Based on what I/we have seen happen (or read about happening) in many and varied situations, what might happen if I/we _____ (do this or that, but perhaps a little differently)."

Modify or Compensate for Other Personal Characteristics And Behavior Patterns

The values and personality traits described in an earlier segment of the series can be discussed in a number of contexts. Managerial styles are one. Problem solving and decision making are another. If you have taken the values and personality tests mentioned earlier, you should be able to gain deeper insights into your problem-solving and decision-making orientations and effectiveness by comparing your scores with the following points.

Values:

A relatively high level of the theoretical (intellectual) value can be an advantage to a problem-solver. A predisposition to ask "why"means that one will probably be more analytic, dig into situations to find underlying as well as superficial causes, and think things out more fully. It also means that one will probably be more inclined to anticipate and consider the results or consequences of alternative solutions. If this type of person is not careful, however, he or she can get bogged down in details and become indecisive. On the other hand, a less thoughtful individual will tend to be higher in other values—values that may be more real-worldly and practical. Consequently, such people may be better at implementing solutions through other people. A balanced approach is generally most effective. Problem solving requires analysis, but it also requires action.

One's value system also affects one's repertoire of knowledge and experience. Both knowledge and experience tend to be greater in those areas or activities that are most important to us. Managers and leaders should occasionally take time to consider their highest and lowest values and the implications for their ability to solve problems in areas that are important to them and their organizations. Remember several earlier examples: Those who are higher in the economic value (concerns for money, financial success, material things) and the political value (concerns for power, influence, or authority over others) will tend to know more about, and think more about, the task-related and organizational variables that may be causes of an organizational problem. On the other hand, they will probably know and think much less about individual and social variables. Those who are higher in the social value (altruism, love of and concern for people) will probably know and think more about people's characteristics and social interactions than about the "mechanics" of operations and what is going on politically in their organizations.

Interests and Other Attitudes:

Interests, beliefs, ethics, and cultural attitudes all affect what one has learned and will learn. As in the case of values, one's interests and other attitudes can maximize knowledge and experience in some areas, but limit them in other areas. They can increase awareness of some problems and dull awareness of others. They can make important problems seem unimportant. They can keep numerous variables and corresponding facts from being considered. They can make facts stated by other persons seem like assumptions or opinions—and vice versa. Not only can attitudinal characteristics hinder the effectiveness of an analysis, but they can also hinder the effectiveness with which solutions are identified and planned. Furthermore, they can hinder the entire problem-solving or decision-making process by reducing open-mindedness and objectivity.

Personality Traits:

The more *adaptable* a manager is, the more honestly and objectively she will tend to think about and solve her problems. On the other hand, if she is too adaptable, she may acquiesce to others' solutions even though she may disagree with them. She may also be too self-critical when thinking about her own behavior.

The more *socially conscientious* a manger is, the more he will tend to consider how his solutions, decisions, or behavior will affect others' needs and feelings. This can make him more effective when thinking and otherwise interacting with subordinates and others.

If a leader is a highly *self-sufficient* person, she may tend to seek and verify information for himself. However, if she is too self-sufficient, she may not bother to seek others' knowledge, ideas, or opinions, even though two heads are better than one. In addition, the leader may want to implement his solutions herself—when others' involvement would be more advisable.

The more *self-confident* a manager is, the more positively and assuredly he will tend to confront problems. Self-confidence in problem-solving and decision-making situations can reflect well-developed thinking capabilities. It can also aid the implementation of solutions or decisions through others. If the manager is confident of his solutions, he will probably be more persuasive when soliciting others' involvement or cooperation. On the other hand, he might be too self-confident and not thoroughly consider the aptness of his own analysis, solutions, or conclusions.

If a leader is highly *dominant*, she may seem too "pushy" to others and fail to gain their cooperation in implementing solutions. On the other hand, if she is not aggressive enough, she may not be inclined to stand up for her own conclusions, solutions, or decisions when appropriate.

If a manager is highly *introverted*, she can tend to be a good thinker, but she may also tend to keep good ideas and solutions to herself. If she is more *extroverted*, she may be somewhat less analytic, but, being more congenial, may be able to implement solutions through others more effectively (unless she is too highly extroverted).

The more *emotionally stable* a leader is, the more his repertoire of knowledge and experience will tend to be logical and objective. In addition, he will tend to approach problems with greater objectivity and less waste of emotional energy.

The more *self-controlled* and self-disciplined a manager orleader is, the better he or she will concentrate and sustain attention and effort on a problem (even though his or her interest and motivation to do so may be relatively low).

Further Develop Implementation Skills

In order to implement solutions as effectively as possible, it is generally advisable to further develop the following: learning and reading skills; greater interpersonal awareness, insight, and sensitivity; communication skills involved in both sending and receiving; physical skills; and general health and energy. Other segments of this series describe how to improve communication processes, further develop communication skills, improve learning processes, and further develop learning skills.

Concluding Remarks

Human beings are extraordinarilly complex systems of brain circuitry, emotion mechanisms, needs or drives, abilities and aptitudes, knowledge and experience, physical traits, values, personality traits, interests, goals, and expectations. All these and many environmental factors influence what we think about and how well we think. Many of these variables limit effective think-work. If we add all these limiting variables together, it is little wonder that problem solving and decision making can be difficult and even unpleasant activities. Nor is it any wonder that we tend to use relatively simplistic approaches rather than the more powerful analytic approach. Nonetheless, as discussed above, all of these factors can be influenced in some way and to some degree so as to increase our effectiveness and efficiency in thinking situations.

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