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THE NEW RATIONAL MANAGER

EFFECTIVE ACTION BEGINS WITH CLEAR THINKING

CHARLES H. KEPNER, BENJAMIN B. TREGOE

Contents

Foreword

Management books, at least the really great ones, are not written in the library or an easy chair. Those rare business books that have withstood the test of time evolve directly from real-world experience and the day-in and day-out struggle of executives, managers, and workers on the front line.

Surely, this explains in part the enduring appeal of *The New Rational Manager* and its several sequels. The original book, published in 1965, described the problem-solving and decision-making approaches developed in the late 1950s by Benjamin B. Tregoe and Charles H. Kepner, two social scientists conducting research on breakdowns in decision making at the Strategic Air Command. They discovered that successful decision making by Air Force officers had less to do with rank or career path than the logical thinking process an officer used to gather, organize, and analyze information before taking action.

Later, Ben Tregoe and Chuck Kepner studied up-close the thinking habits of managers. Some were proficient, others were less so. The distinctions between both sets of managers yielded rich insights into the fundamentals of effective problem solving and decision making.

Ben Tregoe and Chuck Kepner codified their findings into a set of processes—rational processes—which were further tested and refined, added to over the years, until we have the Problem Analysis, Decision Analysis, Potential Problem (Opportunity) Analysis, and Situation Appraisal processes presented here.

Since the original discovery and the founding of Kepner-Tregoe in 1958, Rational Process has been used in hundreds of organizations, large, mid-sized, and small; by top executives, middle managers, and hourly workers; in profit and non-profit organizations and government agencies; across industries and functions; and, globally, across national boundaries.

The “cash value” of ideas, as William James reminds us, is in their practical application. By that standard the Kepner-Tregoe processes have paid handsome dividends to those who have employed them.

These processes have been employed by managers who put astronauts on the moon; by engineers responsible for the life and safety of miners in the tunnels of central Australia; by key managers of one of the world’s largest manufacturers of photographic equipment to launch a multimillion dollar new product effort; by the chairman of a major consumer products company to select a new president; by a major Japanese automobile manufacturer to establish the first Japanese automotive plant site in the United States; by research scientists fighting the incidence of cancer at the Centers for Disease Control and Prevention in Atlanta, Georgia.

Rational Process continues to make a lasting contribution to the discipline of management for one good reason: The approach gets results.

When Ben Tregoe and Chuck Kepner first founded Kepner-Tregoe, the company’s mission was to transfer Rational Process to individuals to improve their performance as managers and workers. Today, Kepner-Tregoe goes beyond individual capability development to implement thinking processes throughout organizations to help them gain sustainable competitive advantage. We call this KT Clear Thinking.

When employees at all levels of a company follow KT Clear Thinking, the results are powerful: increased quality, improved efficiency, and lower costs. Given Kepner-Tregoe’s decades of global experience, we’ve provided a number of examples to illustrate the successes of KT Clear Thinking while using Rational Process.

We hope *The New Rational Manager* adds to your own insights about problem solving and decision making and that Rational Process provides you with the same "cash value" that it has provided to tens of thousands of managers and workers.

Bill Baldwin
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ONE

The Premises of Rational Management

IN THIS CHAPTER

The Search for Organizational Effectiveness

The organization is one of mankind's all-time great inventions. An organization is intended to operate as one unit, with all its parts in efficient coordination. But, too often, it does not. The parts operate at disparate levels of efficiency, or they overlap, or they work against one another's best interests—therefore against the best interests of the organization as a whole. There is misunderstanding and miscommunication, sometimes by accident and sometimes not. Things get done, progress is made. But not enough of the right things get done as well as they should. Progress, however it is defined, does not meet expectations.

The search has been on for many years to find ways of improving organizational effectiveness. Everyone agrees that there is room for improvement, that the organization as we know it is not perfect. Failure of the organization to perform as a functional unit limits full realization of its potential. What to do about it and how to improve the organization to make it more productive and efficient are subjects of great disagreement.

In 1965, we wrote *The Rational Manager*. In that book, we described the concepts and techniques we had developed for using information in problem solving, decision making, and planning for the future. During the period before and after 1965, we conducted week-long workshops for twenty or so executives at a time, offering intensive training in the use of these concepts and techniques. How the executives would apply what they had learned when they returned to their jobs was left largely up to them. Nearly everyone left the workshop determined to put the new ideas to work.

Not surprisingly, results were better in the organizations that promoted and encouraged the continuing use of these ideas. Where there was little or no encouragement to use the ideas, where there were few or no other people who also had been exposed to them, their use dwindled.

Organizations recognized these facts. "Show us how to use these ideas on a team basis" became a familiar refrain. Since the mid-1960s, we have learned a great deal about the ways in which our concepts and techniques can be shared by the members of an organization in a common approach to addressing the tasks of problem solving, decision making, and planning. We have learned how to help our clients establish the teamwork they have come to value at least as highly as discrete management skills. From these clients we have learned what works and what does not. This book, then, has grown out of the experience we and they have amassed since the writing of *The Rational Manager*—years of research, trial, error, and innovation based on what they have told us they want and need.

The Group and the Team

When interacting in a common cause, people can become a cohesive group. Understanding one another as individuals, being consciously sensitive to one another, and knowing how to adapt to individual peculiarities are trademarks of a functioning group that will hold together. Common regard and the psychological benefits that group members derive from the association make group activity desirable and reasonable to achieve. Such a group, however, is not a team.

A team is built primarily on the technical capabilities of its members working in pursuit of specific goals, only secondarily on attraction among the members as individuals. The members of a team must be able to tolerate one another enough to work closely together. Beyond this, all the members must be committed to a common goal and the same set of procedures for achieving that goal.

An athletic team does not win a game because the members like to be together. It wins because it plays smart, knows how to play the game better than the opposition, avoids unnecessary errors, and pulls together as a coordinated unit. Camaraderie may grow out of mutual respect for one another's abilities, but this is usually the result, not the purpose, of the team. Most certainly, it is not the mechanism that makes the team succeed. The overall goal of a team is to win, and every member keeps this firmly in mind. But when you analyze *how* a game is won, you discover that it happens because all the players know what to do and how to coordinate their efforts.

Building a Management Team

Consider now the successful management team, so fervently sought after. The members are specialists in all required areas of expertise, with unique contributions to make by virtue of unique experiences and knowledge. They are necessarily different sorts of people: the entrepreneur with an aggressive, driving nature and quick insights; the financial expert, with a measuring kind of intelligence and a finely developed ability to move patiently while being pushed; the sales and marketing executive, with unbounded enthusiasm and, sometimes, unbounded impatience; the director of research and development, able to control the balance between the feasible and the desirable; and the production manager, motivated chiefly by the realities of what it takes each day to get the product out the back door. All these men and women were hired because they were different and had different things to offer. They might not choose each other's company for a weekend trip, but, given common organizational goals to work toward and a method for coordinating their efforts, they could become an unbeatable management team.

What kind of method for coordinating their efforts? One consisting of simple, common, sensible guidelines and procedures expressed in a commonly understood language. These guidelines and procedures should bridge the differences within the team and its individual functions, and allow the team members to jointly carry out their responsibilities without inhibiting each other's contributions. They should also keep the team focused and prevent the addition of new tasks that are not essential.

Just as you would give the members of an athletic team routines and techniques that would help them coordinate their individual abilities to win the game, you should give a management team common guidelines and procedures for gathering, sharing, and using information to solve problems, make decisions, and safeguard the organization's future. Now let's extend the analogy a bit further. Sports rise above local language and culture. A Brazilian soccer player, for example, can play the game in any country. He can move from one team to another because the rules are international and transcultural. The skills of good team playing are transferable in sports, and so it is in management. A competent manager can be a member of many teams, contributing wherever there is a need for his or her skills and experience, and be an active partner in the coordinated activity that makes an organization thrive.

One of our clients, a large commodity-trading corporation with operations in twenty countries, faced a series of difficult decisions. Should the company continue to rent storage and handling facilities in the Port of Antwerp or move to some other location in Europe? If the company were to seek another location, where? Once a location had been agreed upon, how should the company operate it? Build new facilities? Rent existing ones? Form a joint venture with someone having such facilities? Once the type of operation was decided, what would be the best way to communicate and sell the recommendation to all the others involved? How would foreign exchange, time and cost of shipping, and sales and marketing considerations be integrated into this decision?

A task force of executives from five nations convened in Europe. They were from different organizational levels, with different kinds of expertise and different native tongues. Many of them had never worked together—some had never even met—but all of them were familiar with Kepner-Tregoe decision-making concepts. Although some of the managers had originally learned the concepts in French, German, or Italian, everyone was fluent enough in English to use that as the common language.

Over the next two days they worked their way through the entire set of decisions. "They knew where to start, what questions to ask, what to do," said the vice president for international operations. "They really did work as a team. With that approach to decision making, a term such as 'objectives' had only one, very specific meaning. Such a simple thing, you might think, but it meant that with a minimum of internal translation, each person was able to grasp what was going on all along the way, to ask and answer questions so that everybody understood what everybody else was saying. Which is not usual in such a situation, I can tell you. I have never attended a meeting that covered so much ground, in which so little time was wasted trying to figure out what people meant by what they said."

One does not have to go to Antwerp to find different backgrounds, points of view, or ways of speaking. Put sales, production, and finance people of any organization together in the same room, and you may see the same result. Knowing where to start, what questions to ask, and what to do is just as important, regardless of whether people all come from the same geographical area or even from the same building.

A team that functions efficiently can be put together, but it must be *managed* into being. If you wish to develop an organization to its full potential, many things must be done in addition to teaching and installing a common approach and a common language for addressing management concerns. Introducing the concepts presented in this book is only the first step toward realizing their benefits. Continual, routine, shared use of the concepts must be planned for and implemented by the organization if these benefits are to be achieved and maintained.

Case History: Installing Rational Process

After a number of highly successful years in office, an executive in one company of a medium-sized conglomerate was promoted to the position of president and chief executive officer of the entire organization. The organization was stale. This fact was denied by no one. Under tight control by the previous president and major stockholders, with decision making confined almost exclusively to the top level, rifts and cliques had developed. One company within the conglomerate was played off against another to the detriment of overall productivity. The notion of mutual responsibility was unknown. Major problems had been ignored or swept under the rug for years. Now our executive was in the top position, not an altogether enviable one.

He contacted Kepner-Tregoe and explained that he wanted to build a management team around the use of our approaches. Five years earlier he had attended one of our workshops. He had believed then and ever since that the shared use of the ideas could do much to build teamwork among his organization's managers. Now he was able to put that belief to the test. He wanted managers at all levels—in all companies within the organization—to learn and use the Kepner-Tregoe approaches individually and together. He felt that this experience would enable the managers to begin to see themselves as managers of a single organization, not as vassals of a collection of fiefdoms.

Under his leadership, the new president and his twenty-four senior executives were the first to learn and use the concepts. They analyzed nearly thirty situations in the first week, some of which had been avoided for years. Some were resolved; decisions were made to correct many more. Soon after, another group of managers went through the same procedure. They learned to use the concepts, put them to work identifying and analyzing situations of major concern, and planned for continuing their analyses to the point of resolution. Shortly thereafter, a final group of managers followed suit. In this way, over a period of two months, eighty-four managers learned to use common approaches for addressing and resolving management concerns. New systems and procedures were established to support continuing use of these approaches.

By his actions, the new president said these things loudly and clearly, and everyone in the organization heard them:

- This is one organization.
- By using common approaches to solving problems and making decisions, we can work together cooperatively as parts of one organization.

- Everyone will use these approaches, beginning with me.
- You can think. Your knowledge and experience are important. You are in a position to effectively use the new approaches you have learned.
- What you do with these approaches will have an important impact on the organization.
- You are all valuable members of the management team.

The climate of that organization changed rapidly. People learned to talk about problems that had never been discussed openly before. They learned how to communicate good ideas so others could understand why they were important. Through the use of systematic, commonly shared approaches, they solved more problems and made better decisions than they had before. Who knows how much of this conglomerate's subsequent success was due to the use of systematic, commonly shared approaches, and how much to the sense of participation and pride engendered by the overall set of changes? The question is academic. One element without the other could not have produced the same result.

The president in this example let his people know he believed they could think. He wanted them to express their ideas; he would listen to them, and he wanted them to listen to each other. He provided them with new conceptual tools so they could do a better job of working with available information. He led the way by using the new ideas himself. He established credibility for the new approaches by putting them to the test on real and important situations. He let people learn for themselves that the approaches worked in solving the kinds of concerns faced by the conglomerate and all its components.

- He made a *planned intervention* into his organization.
- He introduced the kinds of *major changes* he believed would do the most good.
- He introduced a *new idea* to his people: I value your ability to think, to come up with good ideas, to express those ideas individually and cooperatively.

- ➢ He introduced *a means by which thinking could be coordinated and channeled. The climate of cooperation and teamwork followed and was a result of the intervention.*
- ➢ Finally, he modified the systems and procedures of the organization to *provide support* for the continuing use of the new ideas.

The new president did not set out to build teamwork or group cohesiveness as desirable things that would somehow improve the operation of the company. He did not try to heal the scars of past in-fighting and conflict. He let teamwork, cohesiveness, and mutual respect grow out of the experience of working together with common guidelines and procedures. He made sure the results of that experience—problems accurately identified and resolved, decisions well formulated and successfully implemented—were recognized and rewarded.

Conditions for Workable Change

For years, social scientists have said that humans resist change—and so they do. But they resist only those changes they do not understand, are suspicious of, or consider to be against their interests. Humans embrace change that seems good for them or good for the world they live in and care about.

A new idea or a new expectation, in itself, will seldom bring about change. On the other hand, change can be very attractive if it is the product of a new idea or expectation that appears to be in the best interests of the people who are expected to adopt it, if it is accompanied by the means for its fulfillment, and if it results in recognition and approval. To improve an organization, we must introduce good ideas, establish the means for making them work, and provide a visible payoff for the effort involved.

No organization can reach its full potential unless it promotes and enjoys the coordination of productive activities among its members. The more complex the activities of the organization, the more need there is for coordination if the organization is to flourish. No one knows it all anymore. Teamwork is an increasingly critical element in organizational success. Fortunately, teamwork can be achieved by creating and nurturing the conditions that produce it.

Four Basic Patterns of Thinking

A foundation for effective teamwork can be laid by teaching the people involved to consciously use the four basic patterns of thinking they already use unconsciously. These four basic patterns of thinking are reflected in the four kinds of questions managers ask every day:

What's going on?

Why did this happen?

Which course of action should we take?

What lies ahead?

What's going on? begs for *clarification*. It asks for a sorting out, a breaking down, a key to the map of current events, a means of achieving and maintaining control. It reflects the pattern of thinking that enables us to impose order where all has been disorder, uncertainty, or confusion. It enables us to establish priorities and decide when and how to take actions that make good sense and produce good results.

Why did this happen? indicates the need for *cause-and-effect* thinking, the second basic pattern. It is the pattern that enables us to move from observing the effect of a problem to understanding its cause so that we can take appropriate actions to correct the problem or lessen its effects.

Which course of action should we take? implies that some *choice* must be made. This third basic pattern of thinking enables us to decide on the course of action most likely to accomplish a particular goal.

What lies ahead? looks into the future. This fourth basic pattern of thinking enables us to assess the problem that *might* happen, the decision that *might* be necessary next month, next year, or in five years.

Four kinds of questions. Four basic patterns of thinking. Of course, people ask other questions and think in other patterns. Nevertheless, every productive activity that takes place within an organization is related to one of these four basic patterns.

In the Beginning: Thinking Patterns for Survival

The four basic patterns of thinking have not altered substantially since the emergence of the human race. The patterns are universal and applicable to any situation. Over millions of years, through natural selection, these neurological structures—the patterns of thinking, response, and behavior that promoted survival—tended to be preserved and passed on; patterns with low survival value dropped out. Humans became adaptive (problem solving) in their way of life. The elements that made possible those patterns of thinking became part of human nature.

The ability to ask and answer these four questions—"What's going on?" "Why did this happen?" "Which course of action should we take?" and "What lies ahead?"—made civilization possible. By accumulating answers to these questions, humans learned how to deal with complexity, how to discover why things are as they are, how to make good choices, and how to anticipate the future.

Survival was guaranteed by the ability to use these patterns, to think clearly, and to communicate with one another for a common purpose. To most people, "survival" implies a teetering on the edge of death and a need for constant individual effort to remain alive. In mankind's distant past, when survival concerned the individual alone, this may indeed have been true. But survival depended more often upon the actions of a group of individuals working together, perhaps as a hunting or food-gathering group. The group became a team by working together. Teamwork ensured a food supply for everyone. Teamwork ensured shelter, protection, and a basis for living in a brutally competitive world. There was a place for physical strength, but brains combined with strength counted for far more.

Pattern 1: Assessing and Clarifying

For our earliest ancestors, the most important of the four basic patterns of thinking was the one that enabled them to assess, clarify, sort out, and impose order on a confusing situation. Humans could separate a complex situation into its components, decide what had to be done, and determine when, how, and by whom it would be done. They could set priorities and delegate tasks. This was an integral part of human adaptability—the condition that permits us to change based on an assessment of "What's going on?" Animals adapt and change in response to external changes, but human adaptation is a chosen behavior resulting from such assessment. Twenty thousand years ago, the answers to "What's going on?" may have pointed to a slowly vanishing food source, a recurring flood, or an influx of animal pests. In response, humans took the steps necessary for survival. They moved to a new location, altered eating habits, adopted better hunting practices. In short, this fundamental pattern of thinking enabled humans to prevail in a variety of surroundings and against an array of profoundly adverse conditions.

Pattern 2: Relating Cause to Effect

The second basic pattern of thinking—the one that permits us to relate an event to its outcome, a cause to its effect—gave early man the ability to assign meaning to what he observed. The earliest humans did not understand such natural events as birth, illness, and death, or the rising and setting of the sun. That understanding came much later, through the accumulation, contemplation, and communication of observations about their world. It was the refinement of cause-and-effect thinking that enabled humans to move beyond mere reaction to their environment, to make use of the environment instead of being forever at its mercy.

Small children constantly ask, "But *why?*" They are exhibiting this basic thinking pattern: the desire to know why things are as they are and why they happen as they do. This desire is so basic that even an inaccurate explanation of a puzzling fact is preferable to none at all. Early man was satisfied with an explanation of a universe that revolved around the activities of supernatural beings. It was far preferable to no explanation at all for such readily perceived phenomena as the changing nature of a star-filled sky. Even today we have relatively few answers to the gigantic puzzle of the universe, but the answers we do have are comforting.

The thinking pattern we use to relate cause to effect is as basic and natural as the pattern we use to assess and clarify complex situations. Both enable us to survive, flourish, and maintain a true measure of control over our environment.

Pattern 3: Making Choices

The third basic pattern of thinking enables us to make reasoned choices. It is the pattern that permitted early man to decide whether to continue the hunt all night or wait until morning, hide in this cave or that tree, camp on this or that side of the river. Productive, coherent action—as opposed to simple reaction to the event of the moment—depends on a sound basis for choice. In a hostile environment populated with larger, stronger, and faster creatures, random action too often could have only one end for early man, and that sudden. The development of sophistication in the making of choices, along with goal setting and consideration of the consequences of one action as opposed to another, meant that humans could sometimes eat tigers instead of vice versa.

The choice-making pattern gives rise to three major activities:

- ➢ Determination of purpose (to what end the choice is being made).
- ➢ Consideration of available options (how best to fulfill the purpose).
- ➢ Assessment of the relative risks of available options (which action is likely to be safest or most productive).

When faced with a choice, we are likely to spend most of our time and thought on only one of these three activities. But whatever the balance, however complex the choice, these three factors determine the kinds of choices humans have always made and continue to make.

Pattern 4: Anticipating the Future

The fourth basic pattern of thinking enables us to look into the future to see the good and bad it may hold. This ability to imagine and construe the future, even a little way ahead and that imperfectly, gave our ancestors a tremendous advantage. It permitted them to anticipate the storm and the snake, the starvation of winter, the thirst of summer. Future-oriented thinking was made possible largely by the superior development of cause-and-effect thinking (the second basic pattern described above). Humans learned to apply their knowledge of cause-and-effect relationships: of what *had happened,* and why, to what *could happen* and what the future *might hold*. They learned to take actions in the present against the possible and probable negative events of the future.

Although preventive action is as old as the human race, the thinking pattern that produces this action is less successful than our other patterns. Unfortunately, the future carries less urgency than the present. Early man learned to keep some of the food of summer against the ravages of winter—but the supply was rarely adequate. The importance of the future tiger, the future fire, or future starvation was small compared with the immediacy of the tiger five yards away, the threat of fire visibly approaching, or the reality of imminent starvation. Even today we face the unfulfilled potential of this fourth basic pattern of thinking: the ability to plan ahead, to take action today against the negative events of tomorrow.

Basic Patterns of Thinking in the Organizational Context

Kepner-Tregoe has developed four basic Rational Processes for using and sharing information about organizational concerns. These processes are systematic procedures for making the best possible use of the four patterns of thinking. This is why the Kepner-Tregoe processes are universally applicable, regardless of cultural setting or the content against which they are applied. Whether managers are Japanese, Canadian, or Brazilian, they are all equipped—as a result of common human experiences—with identical, unchangeable patterns of thinking. It is only the content that changes.

Situation Appraisal

The Rational Process based on the first thinking pattern is called *Situation Appraisal*. It deals with the question "What's going on?" and with assessing and clarifying situations, sorting things out, breaking down complex situations into manageable components, and maintaining control of events.

When a management situation occurs, the available information is usually a confusion of the relevant and the irrelevant, the important and the inconsequential. Before anything reasonable or productive can be done, the situation must be sorted out so that its components can be seen in perspective. Priorities must be set and actions delegated. There must be some means of keeping track of information as old situations are resolved and new ones take their place.

Situation Appraisal is designed to identify problems to be solved, decisions to be made, and future events to be analyzed and planned. Therefore, we must understand the Rational Processes applicable to these areas before studying the techniques and procedures of Situation Appraisal itself. For this reason, Situation Appraisal is presented in Chapter Seven, following the explanation of the three remaining Rational Processes: Problem Analysis, Decision Analysis, and Potential Problem and Potential Opportunity Analysis.

Problem Analysis

The second Rational Process, called *Problem Analysis*, is based on the cause-and-effect thinking pattern. It enables us to accurately identify, describe, analyze, and resolve a situation in which *something has gone wrong without explanation*. It gives us a methodical means to extract essential information from a troublesome situation and set aside irrelevant, confusing information.

Problem Analysis is explained in Chapter Two, and examples of its use are presented in Chapter Three.

Decision Analysis

The third Rational Process, based on the choice-making pattern of thinking, is called *Decision Analysis*. Using this process, we can stand back from a decision situation and evaluate its three components. We can analyze the reasons for making the decision and examine its purpose. We can analyze the available options for achieving that purpose. We can analyze the relative risks of each alternative. From this balanced picture of the situation, we can then make the wisest and safest choice—the one that has emerged after careful consideration of all the factors.

Decision Analysis is explained in Chapter Four, and examples of its use are presented in Chapter Five.

Potential Problem (Opportunity) Analysis

The fourth Rational Process is based on our concern with future events—with what might be and what *could* happen. We call it *Potential Problem and Potential Opportunity Analysis*. A potential problem exists when we can foresee possible trouble in a given situation. No one knows for sure that trouble will develop, but no one can guarantee that it will not. This process uses what we know or can safely assume in order to avoid possible negative consequences in the future. It is based on the idea that thinking and acting beforehand to prevent a problem are more efficient than solving a problem that has been allowed to develop. Likewise, Potential Opportunity Analysis involves looking ahead and anticipating situations that we may be able to turn to our advantage. This Rational Process enables an organization to take an active hand in shaping its future.

Chapter Six deals with the ways organizations have used Potential Problem Analysis to reduce the number and severity of their problems and Potential Opportunity Analysis to benefit from their opportunities.

The Rise, Fall, and Rise Again of Teamwork

All humans have the inherent capacity to think in terms of Situation Appraisal, Problem Analysis, Decision Analysis, and Potential Problem and Potential Opportunity Analysis. These processes are basic and natural. Unfortunately, they cannot be put to work automatically, used equally well by all humans, or shared. Why should this be so?

Every person has a personal, idiosyncratic way of understanding, handling, and communicating such things as cause-and-effect relationships and choice making. Some people develop better ways than others. Some may be only moderately skilled in, say, cause-and-effect thinking, but be exceptionally good at communicating their conclusions. (They may be more successful than others who are more skilled but less communicative.) The way a person thinks can be deduced only by observing that person's behavior and paying careful attention to his or her conclusions. What information was used and how it was used remains invisible. "I don't see how you could arrive at that" is our ordinary way of expressing the fact that thinking is an inside job.

So we have a twofold need, complicated by the fact that we are often unaware of even our own thinking patterns. The actual *level of skill in thinking*—about problems, decisions, and all other organizational concerns—*needs to be as high as it can be.* That level of skill rises when people have grasped the techniques of the Rational Processes and have learned to apply their basic thinking patterns to management concerns. That's the easy part. *It is more difficult for people to learn to think together.* How can we achieve teamwork in an activity as individual and internal as thinking?

Teamwork in the use of patterns of thinking does not just happen. As discussed earlier, it must be contrived, consciously planned, or unconsciously fostered through the closeness and visibility of the team members. A group may become a team of sorts simply by working together on a particular task for a long enough time. They may come to understand each other's roles in a common task. They may come to appreciate each other's ways of thinking and learn to accommodate individual idiosyncrasies in the way information is used. Although a workable set of effective and appropriate compromises may emerge from this context, this group is not yet the full-scale, multipurpose team that can truly share in the thinking process.

Hunting and Gathering: Models of Superior Teamwork

We can gain insight into what is useful in today's organizations by speculating on the achievement and consequences of teamwork exhibited by our earliest ancestors. Teamwork is perceived as a precious commodity today, and the earliest humans had it down pat.

For early man, available information was largely visual: tracks, signs, and indications could be mutually observed and pointed out. Hunting and food-gathering groups were small—probably fifteen to forty people of all ages. The young learned from the old through intimate contact and close observation. Old and young pooled their intellectual resources by talking about what they saw. They thought aloud—a characteristic typical of people who live together closely.

In this way they acquired commonly understood meanings for their words. Their language became expressive of detail, of fine distinctions of form, color, texture, and of thoughts and feelings. They developed few abstract terms. The languages of hunting and gathering groups that survive today retain these characteristics, suggesting how life's business probably was conducted by early man. Although there is no difference between their mental processes and ours, early man's need for communication led to a language rich in concrete, literal words that were open to verification and that had explicit definitions within a shared reality.

With a common experience of their environment and a common set of terms to describe it, the members of a hunting team functioned more as a single coordinated body than any comparable modern group. There was no need for their leader to give orders and directions constantly. Everyone understood what was to be done, who could do it best, and how to mesh individual efforts into a concerted whole. Entire vocabularies were committed to sign language to preserve silence. Hundreds of words could be expressed by formalized gestures, instantly and commonly understood.

It is little wonder that hunting and gathering people were able to achieve such a high order of coordination and teamwork in their activities. It was as though they carried computers within themselves, all of which were commonly programmed with a single shared set of routines and instructions. With these computers so closely aligned, even a little information was sufficient to trigger a common understanding among all those who received it. They knew what the information meant and what was to be done with it. There was little ambiguity or uncertainty in the treatment of and response to an input. Success and survival depended upon everyone's getting the same message at the same time. Teamwork among humans probably reached its highest point of development immediately before the advent of agriculture. This teamwork was made possible by the possession of a common language to express and share a common way of thinking.

The domestication of plants and animals doomed the hunting life. No longer was it necessary for the members of a band to think and exist in so parallel a fashion. Now there was specialization of function.

Groups became larger, and diverse social and political units appeared. Now there was room for different beliefs and behavior. Gone was the economic uncertainty of hunting and gathering, but gone also was the closeness such a life imposed. The intense teamwork of the hunting group disappeared forever; the luxury of individual thought and individual interpretation of ideas had arrived.

Applying the Model: Needs of the Modern Organization

No one in his right mind wants to go back to the days of hunting and gathering. But it would be tremendously valuable if we could recapture that ability to work together, with even a fraction of that efficiency, to deal better with modern problem situations. Now, through contrivance and planning, we can recapture that ability and channel it to meet the needs of the modern organization.

This is not to say that the organizational team will somehow represent a modern hunting group armed with ballpoint pens instead of bows and arrows. Hunters' ways of thinking were totally aligned, and their lives were totally aligned. What is required today is not total teamwork in all aspects of life; rather, it is a selective, functional teamwork that can be turned on when needed, limited to those activities where it will be most productive. What is required is teamwork that can be summoned to handle organizational problems yet leave team members free to act as individuals in all other respects.

When we need answers to specific questions, we need an approach that can be invoked and shared regardless of content. The "What's going on?" applies order to complexity and confusion. The "Why did this happen?" applies to any set of circumstances in which the cause-and-effect relationship is obscure. The "Which course of action should we take?" applies to any situation in which one course of action must be adopted over others. The "What lies ahead?" must be thoughtfully considered to protect and nurture the organization's future.

We need the kinds of accurate communication and common understanding that prevailed in the hunting bands. These must be modernized, selectively adapted to current conditions, and directed toward the critical functions of organizational activity where teamwork is most essential.

All of this can be done. It is exactly what was done by the new president mentioned earlier in this chapter. He brought into his organization a common language and common approaches for using the four basic patterns of thinking to produce order, resolve problems, make good choices, and protect against future threats. His people learned to share this language and use these approaches. Their acceptance of his new and different modus operandi came as a result of their own experience.

The new, common language they learned was not a long list of jargon that required a month to memorize. It consisted of down-to-earth words and phrases that conveyed an exact meaning to everyone exposed to that language. Such sentences as "I'm not sure you really understood what I meant" were heard less and less frequently. The new, common approaches worked when they were applied to actual situations within the organization. The individual payoff for adopting the new behavior was great; the organizational payoff was greater. The people of the organization soon were equipped to act as a team in the fullest sense of the word.

Rational Management

Such results begin to occur only after planning and plain hard work. Rational management, which *means making full use of the thinking ability of the people in an organization,* is a continuing process. Use of the ideas—and their benefits—will eventually fade out if they are not continually used and reinforced.

Rational Management aims at major change and therefore demands major commitment. The four Rational Processes we will describe in the next several chapters constitute an explicit, logical system that can have a far-reaching impact within an organization. But this system cannot be introduced by halfheartedly sprinkling a few ideas and suggestions among a random mix of the organization's people in the hope that something good will happen. We must identify the people who have the greatest influence on the important issues facing the organization. They should be the first to learn and use the new ideas. We must identify the people who provide them with information. We must identify those who will implement the conclusions that come out of the use of the ideas. In short, it is imperative to pinpoint *all the people within an organization who make things happen*. The objective is to move the organization closer to its full potential. This can only be done by introducing teamwork based on the continuing *conscious* use of common approaches expressed in a simple, common language and directed toward resolution of an organization's important concerns.

TWO

Problem Analysis

IN THIS CHAPTER

The Conditions and Skills of Problem Solving
The Structure of a Problem
The Process of Problem Analysis

The Conditions and Skills of Problem Solving

People like to solve problems. While people in organizations enjoy the rewards that go with success, they also enjoy the process that produces success. Regardless of their organizational level, they will not only accept but will also seek problem-solving opportunities as long as four conditions exist:

- ➢ They possess the skills needed to solve the problems that arise in their jobs.
- ➢ They experience success in using those skills.
- ➢ They are rewarded for successfully solving their problems.
- ➢ They do not fear failure.

The converse is equally true. People will avoid problem-solving situations when they are unsure of how to solve their problems, when they do not experience success after trying to solve a problem, when they feel that their efforts are not appreciated, and when they sense that they have less to lose either by doing nothing or by shifting responsibility. This chapter is concerned with the first condition: *the skills that make problem-solving behavior possible*. The other conditions for habitual, successful problem solving will be discussed in subsequent chapters.

Problem Analysis provides the skills needed *to explain any situation in which an expected level of performance is not being achieved and in which the cause of the unacceptable performance is unknown*. If "any situation" seems too strong a phrase, remember that we are concerned with *the way in which information is used to approach deviations in performance*. These deviations may appear in the performance of people or the performance of systems, policies, or equipment, that is, anything in the work environment that may deviate from expected performance with no known cause. As long as this structure applies, the techniques of Problem Analysis also apply.

In this chapter, we will explain and demonstrate Problem Analysis by examining a problem that occurred in a production plant owned by one of our clients. We have selected this problem as a case vehicle because it is concrete and easily understood, therefore ideal for introducing the techniques of Problem Analysis. In Chapter Three, we will describe the use of these techniques in a variety of industries, at differing organizational levels, and over a wide spectrum of problem situations.

Cause and Effect

Problem solving requires cause-and-effect thinking, one of the four basic thinking patterns described in Chapter One. A problem is the visible effect of a cause that resides somewhere in the past. We must relate the effect we observe to its exact cause. Only then can we be sure of taking appropriate corrective action—action that can correct the problem and keep it from recurring.

Everyone has experienced the "solved" problem that turns out not to have been solved at all. A simple example is the car that stalls in traffic, goes into the shop for costly repair, and then stalls again on the way home. If the cause of the stalling is a worn-out distributor and the action taken is a readjustment of the carburetor, then the car will continue to stall. Superior problem solving is not the result of knowing all the things that can produce a particular effect and then choosing a corrective action directed at the most frequently observed cause. Yet this is the way most people approach problems on the job. Problem Analysis is a systematic problem-solving process. It does not reject the value of experience or of technical knowledge. Rather, it helps us to make the best use of that experience and knowledge. Our objectivity about a situation is often sacrificed under pressure. When a quick solution to a problem is required, it is too easy to rely on memories of what happened in the past, on the solution that was successful once before, or on the remedy that corrected an apparently similar problem. This is the most common approach to problem solving, and problem solving by extrapolation is a tough habit to break despite its relatively poor payoff in appropriate, lasting corrective actions. A chief purpose of this chapter and the next is to demonstrate that the habit can be broken. Through the experiences of people in our client organizations, we will show that the effort required to adopt a systematic approach to problem solving is small in light of the results that follow.

The Criteria That Define a Problem

The following are typical examples of problems. They meet our definition of a problem because in each one an expected level of performance is not being achieved, and the cause of the unacceptable performance is unknown.

> "From the day we introduced the computer, we've had nothing but trouble in getting our inventories to balance. I just don't understand it."

> "Emory Jackson was referred to us as an outstanding engineer, but he certainly hasn't fulfilled expectations in this department."

> "Our Number Eleven paper machine never produces more than 80 percent of its design capacity, no matter what we try."

> "Some days we meet our schedules without any trouble. Other days we can't meet them at all. There just doesn't seem to be any good reason for the discrepancy."

> "The system worked well for months. Then, in the middle of the morning three weeks ago, it went dead. It's still dead, and we don't have the slightest idea of what happened."

Despite disparities in content, seriousness, and scope of these five examples, they all indicate a degree of performance failure, confusion or total lack of understanding about its cause, and the need to find a correct explanation.

There are other kinds of problem situations that do not meet our specific definition. For example:

> "There is no way we can meet our deadline on the project with our present staff and no way we can get authorization to bring on anyone new. This is a serious problem. . . ."

This statement represents the need for one or more decisions. It does *not* represent a deviation between expected and actual performance that is of *unknown* cause. In this example, resolution will consist not of an explanation as to why the situation arose but of a choice. Those concerned must identify some course of action that can produce satisfactory results under less-than-optimal conditions.

Compromises will probably be identified. Objectives for meeting the goal may have to be reviewed, reshuffled, or altered. Any number of potential actions may be considered. But the cause of the difficulty is known all too well. Decision Analysis, which is presented in Chapters Four and Five, is useful for resolving this kind of dilemma. A decision requires answers to the following questions: "How?" "Which?" "To what purpose?" A problem always requires an answer to the question "Why?"

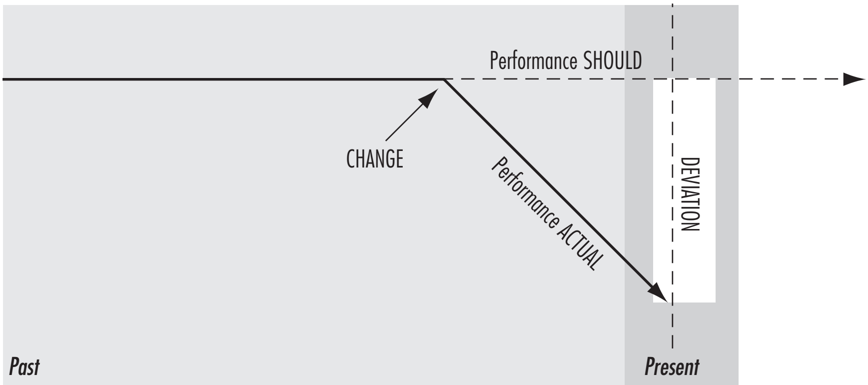
The Structure of a Problem

A performance standard is achieved when all conditions required for acceptable performance are operating as they should. This is true for everything in the work environment: people, systems, departments, and pieces of equipment. If there is an alteration in one or more of these conditions—that is, if some kind of change occurs—then it is possible that performance will alter, too. That change may be for better or for worse. Sometimes conditions improve, positive changes occur, and things go better than expected. But an unexpected rise in performance seldom triggers the same urgent response as an unexpected decline. The more serious the effect of the decline, the more pressure there is to find the cause and do something about it.

We may visualize the structure of a problem as shown in Figure 1.

FIGURE 1

STRUCTURE OF A PROBLEM

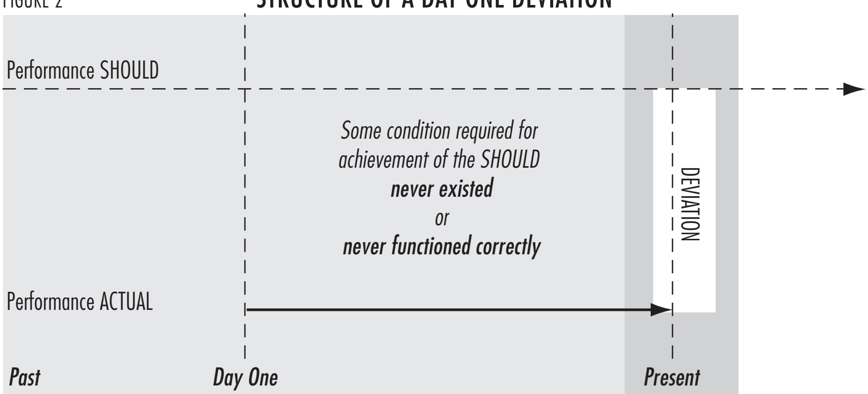


If performance once met the SHOULD and no longer does, then a change has occurred. At the outset of problem solving, we do not know exactly what that change consisted of or when it occurred.

The search for cause usually entails a search for a specific change that has caused a decline in performance. In some cases, however, a negative deviation in performance—a so-called Day One Deviation—has always existed. An example is an equipment unit that "was never any good *from the day it came on line. . . .*" In this instance, using our terminology, ACTUAL has always been below SHOULD. This kind of problem can be visualized as shown in Figure 2.

FIGURE 2

STRUCTURE OF A DAY ONE DEVIATION



The Process of Problem Analysis

Both kinds of problems—a current deviation from formerly acceptable performance and a performance that has never met expectations—can be approached through the techniques of Problem Analysis.

The techniques of Problem Analysis are divided into these activities:

- ➢ State the problem.
- ➢ Specify the problem.
- ➢ Develop possible causes from knowledge and experience or distinctions and changes.
- ➢ Test possible causes against the specification.
- ➢ Determine the most probable cause.
- ➢ Verify assumptions, observe, experiment, or try a fix and monitor.

Case History: The Leaking Soybean Oil Filter

The history of our true case vehicle is a necessary prelude to demonstrating the Problem Analysis techniques. The Case of the Leaking Soybean Oil Filter may never make a best-selling mystery, but, as with most real-life mysteries, to the people who had to live with it, explain it, and correct it, it was of far more interest than any best-seller. Although Problem Analysis was used *after* the explanation had been arrived at (quite accidentally), it demonstrated—to the people who had worked on the problem inefficiently and unsuccessfully for several days—that a systematic investigation process would have produced the correct explanation within a matter of hours.

Our client is a major food processor. One of the company's plants produces oil from corn and soybeans. The five units that filter the oil are located in one building. On the day the problem was first observed, a foreman rushed into his supervisor's office: "Number One Filter is leaking. There's oil all over the floor of the filter house."

The foreman guessed that the leak was caused by valves loosening up from vibration. This had happened once before. "Number One sits right next to the main feedwater pump and gets shaken up more than the other four filters." A mechanic tried to find the leak but couldn't tell much because the oil had already been cleaned up. The lid fastener looked all right. After examining the pipes, valves, and walls of the filter chamber, the mechanic concluded that the oil had spilled from another source.

The next day there was more oil. Another mechanic traced the leak to the cleanout hatch, but that didn't help much. Why should the cleanout hatch leak? It looked perfectly all right. Just to be on the safe side, he replaced the gasket even though it looked new. The hatch continued to leak. "Maintenance people just aren't closing it tight enough after they clean it out," someone volunteered. "There are a couple of new guys on maintenance here since the shifts were changed around last month. I wonder if they're using a torque wrench like they're supposed to. This happened to us once before because somebody didn't use a torque wrench." No one could say for sure.

The next day an operator slipped on the oil slick floor and hurt his back. The cleanup task was becoming more than irksome, according to some outspoken comments overheard by the foreman. A few people began grumbling about promises made at the last safety meeting to improve conditions in the filter house. Two days later the plant manager got wind of the situation, called in the supervisor and the foreman, and made it clear that he expected a solution to the oil-mess problem within the day.

That afternoon someone asked, "How come the gasket on the Number One Filter has square corners? They always used to have rounded corners." A quick check of the filters revealed that the other four filters still had round-cornered gaskets. This led to the discovery that the square-cornered gasket on the Number One Filter had been installed the evening before the leak was first noticed. It had come from a new lot purchased from a new supplier who charged 10 cents less per unit. This led to the question "How can they sell them for 10 cents less?" and to the subsequent observation "Because they don't work."

The new gasket was inspected and compared with the old gaskets. It was easy to see that the new one was thinner and uneven. It was equally clear that this gasket had never been designed to be used on this kind of filter unit. It would always leak. It should never have been installed. Additional gaskets were purchased from the original supplier and installed. The leaking stopped.

Looking back at the problem, a few people said they had had ideas about its cause but couldn't explain how the cause they had thought of could have produced the effect. Actions taken before the problem was solved had been based on experience, on similar problems in the past, on standard operating procedures, and on hunches. The faulty gasket had even been replaced with an identical (and therefore equally useless) one "just to be on the safe side."

Sometimes we stumble onto the cause of a problem. Sometimes we take an action that just happens to correct the effect, although the cause is never explained fully. In the latter case—cause is unknown and the action that solved the problem is one of many taken at the same time—a recurrence of the effect will mean that all those same actions may have to be repeated to ensure correction!

At other times the cause is neither discovered nor stumbled upon, and *no* action corrects the effect. An interim, or holding, action must be devised so that the operation can live with the problem until its true cause is found—or until problem-solving roulette produces a winning number. That happy accident occurs less often than managers would like. Interim action gradually becomes standard operating procedure.

The Case of the Leaking Soybean Oil Filter was reconstructed as a Problem Analysis for plant employees who were learning to use the techniques. It made the point very well that the roulette approach, however familiar, produces frustration and misunderstanding more often than results. Motivation to use a systematic approach grew as soon as the employees recognized that they had worked for several days on a mess that could have been corrected permanently in a matter of hours.

The remainder of this chapter is a step-by-step demonstration of Problem Analysis, exactly as it could have been used when the leaking oil filter problem was first observed.

STATE THE PROBLEM

Before we can describe, analyze, and explain a problem, we must define it. We do this with the *problem statement*, or the name of the problem. It is important to name the problem precisely because all the work to follow—all the description, analysis, and explanation we will undertake—will be directed at correcting the problem *as it has been named*. The name of this problem is "Number One Filter Leaking Oil."

This seems obvious enough. But suppose we had worded the problem statement "Oil on the Filter House Floor." Any way you look at it, oil on the floor is certainly a deviation from SHOULD. Yet it is of known cause, and all that a logical analysis can produce as an explanation is "Number One Filter Leaking Oil." This is where we want to begin our search, not end it.

However simple or complex a problem may seem at the outset, it is always worth a minute or two to ask, "Can the effect of this problem *as we have described it* in the problem statement be explained now?" If it can, as in "Oil on the Floor," we must back up to the point at which we can no longer explain the problem statement.

Vague or generalized problem statements that begin with such phrases as "Low productivity on . . ." or "Sub-standard performance by . . ." must be reworded into specific problem statements that name one object, or kind of object, and one malfunction, or kind of malfunction, for which we wish to discover and explain cause. We must describe exactly what we see, feel, hear, smell, or taste that tells us there is a deviation.

It is tempting to combine two or more deviations in a single problem-solving effort or to try to bunch a bevy of seemingly related problems into one overall problem. Nearly everyone has attended meetings during which two or more distinct problems were tied ankle to ankle in a kind of problem-solving sack race. This procedure is almost always inefficient and unproductive.

SPECIFY THE PROBLEM

Once we have a precise problem statement, the next step in Problem Analysis is to describe the problem in detail or to specify it in its four dimensions:

WHAT– the identity of the deviation we are trying to explain

WHERE– the location of the deviation

WHEN– the timing of the deviation

EXTENT– the magnitude of the deviation

FIGURE 3

SPECIFY THE *IS*

	SPECIFYING QUESTIONS	*IS—PERFORMANCE DEVIATION*
WHAT	WHAT specific object has the deviation?	Number 1 Filter
	WHAT is the specific deviation?	Leaking oil
WHERE	WHERE is the object when the deviation is observed (geographically)?	At the northeast corner of the filter house
	WHERE is the deviation on the object?	At the cleanout hatch
WHEN	WHEN was the deviation observed first (in clock and calendar time)?	3 days ago, at the start of the shift
	WHEN since that time has the deviation been observed? Any pattern?	Continuously, on all shifts
	WHEN, in the object's history or life cycle, was the deviation first observed?	As soon as oil goes into the filter, at the start of the shift
EXTENT	HOW MANY objects have the deviation?	Number 1 Filter only
	WHAT is the size of a single deviation?	5-10 gallons of oil leaked per shift
	HOW MANY deviations are on each object?	N/A
	WHAT is the trend? (…in the object?) (…in the number of occurrences of the deviation?) (…in the size of the deviation?)	Stable—leaks daily, about the same amount

Information on the effects of any deviation will fall within one of these four dimensions. Within each we ask *specifying questions* that will flesh out our description of how the deviation presents itself to our senses. The answers to the questions will give us exactly the kinds of information that will be most useful for the analysis. See Figure 3.

In the dimension of EXTENT, the response to "How many deviations are on each object?" is N/A—not applicable. This illustrates the fact that every problem is unique, and its context reflects that uniqueness. As a result, one or more of the specifying questions may not produce useful information. Nevertheless, we ask. We always attempt to answer every question. Skipping questions that probably don't matter destroys the objectivity we are working so diligently to maintain.

Given only a few variations in wording, any problem can be described by answering the specifying questions—whether the problem concerns a unit, a system, part or all of a function, or human performance. Our choice of wording should indicate that our five senses have detected a problem. When we are dealing with a human performance problem, however, we must alter the questions to reflect the fact that we are observing people and behavior, not units and malfunctions. There are other variations on the basic techniques. When we are working with human performance, we usually need to use a combination of Rational Process ideas—not only those found within the Problem Analysis process. For these reasons, human performance is dealt with separately in Chapter Eight, after all the Rational Processes have been explained.

Once we have described our problem in the four dimensions of WHAT, WHERE, WHEN, and EXTENT, we have the first half of the total specification we want. It is the second half that will render it a useful tool for analysis.

IS and IS NOT: A Basis of Comparison

We know that our problem IS "Number One Filter Leaking Oil." What would we gain by identifying a unit that COULD BE leaking but IS NOT? Or the locations at which oil COULD BE observed to leak but IS NOT? Such data would give us what we need to conduct an analysis: *a basis of comparison*. Once we have identified COULD BE but IS NOT data, we will also be able to identify the peculiar factors that isolate our problem: exactly what it is, where it is observed, when it is observed, and its extent or magnitude. These peculiar factors will lead us closer to the problem's cause.

Suppose for a moment that you have two identical potted plants growing in your office. One thrives but the other does not. If you take the wilting plant out of the office and ask someone about the probable cause for its sorry appearance, you will get any number of educated guesses. But if the same person observes that the two plants have not been receiving identical treatment (the thriving plant is on a sunny window sill; the wilting one, in a dim corner), speculation as to the cause will be immediate and more accurate than it could have been without a basis of comparison. *Regardless of the content of a problem, nothing is more conducive to sound analysis than some relevant basis of comparison*.

In Problem Analysis, we conduct the search for bases of comparison in all four dimensions of the specification. We will now repeat our problem statement and the specifying questions and answers, and add a third column called Closest Logical Comparison. In this column, we will establish the problem as it COULD BE but IS NOT in terms of WHAT, WHERE, WHEN, and EXTENT. The closer the comparison, the more tightly the dimensions of the problem will be defined. Let us see how this works out in Figure 4.

Note that the second specifying question in the WHAT dimension does not suggest a close, logical comparison. In this case, leaking oil cannot be compared usefully with any other specific malfunction with the hatch. The decision as to what is close and what is logical must rest with the judgment of the problem solver or the team. In many cases, it is extremely important to identify the malfunction that COULD BE but IS NOT in order to narrow the scope of the search for cause. Each Problem Analysis is unique to the content of each problem.

Once we have identified bases of comparison in all four dimensions, we are able to isolate key distinguishing features of the problem. This approach is similar to describing the outlines of a shadow. With the completion of the IS NOT data in our specification, the outlines begin to suggest the components capable of having cast the shadow.

FIGURE 4 **SPECIFY THE PROBLEM**

PROBLEM STATEMENT: Number One Filter Leaking Oil

	SPECIFYING QUESTIONS	*IS—PERFORMANCE DEVIATION*	*IS NOT—CLOSEST LOGICAL COMPARISON*
WHAT	WHAT specific object has the deviation?	IS Number 1 Filter	COULD BE but IS NOT Numbers 2-5
	WHAT is the specific deviation?	IS leaking oil	(No logical comparison)
WHERE	WHERE is the object when the deviation is observed (geographically)?	IS observed at the northeast corner of the filter house	COULD BE but IS NOT observed at other filter locations
	WHERE is the deviation on the object?	IS observed at the cleanout hatch	COULD BE but IS NOT observed at other filter locations, at cleanout hatches of Numbers 2-5
WHEN	WHEN was the deviation observed first (in clock and and calendar time)?	IS first observed 3 days ago, at the start of the shift	COULD BE but IS NOT observed before 3 days ago
	WHEN since that time has the deviation been observed? Any pattern?	IS observed continuously, on all shifts	COULD BE but IS NOT observed when the unit is not in use
	WHEN, in the object's history or life cycle, was the deviation first observed?	IS first observed as soon as oil goes into the filter, at the start of the shift	COULD BE but IS NOT observed at a time later on in the shift
EXTENT	HOW MANY objects have the deviation?	IS Number 1 Filter only	COULD BE but IS NOT Numbers 2-5
	WHAT is the size of a single deviation?	IS 5-10 gallons of oil leaked per shift	COULD BE but IS NOT less than 5 or more than 10 gallons per shift
	HOW MANY deviations are on each object?	N/A	N/A
	WHAT is the trend? (…in the object?) (…in the number of occurrences of the deviation?) (…in the size of the deviation?)	Stable—leaks daily, about the same amount	COULD BE but IS NOT increasing or decreasing in frequency or in size

DEVELOP POSSIBLE CAUSES FROM KNOWLEDGE AND EXPERIENCE OR DISTINCTIONS AND CHANGES

Knowledge and Experience

We usually have ideas about the possible causes of a problem, but, given the benefit of the IS/IS NOT comparison, some new ideas may come to mind while others may seem less plausible. Experts and those close to the problem may have ideas about possible causes but will still find the information in the specification useful. Brainstorming is an effective technique to use to quickly list many ideas without evaluating or discussing them. The purpose is to cast a large net in search for the true cause.

In all cases, a short statement that describes how the cause works is needed. Simply pointing to the gasket as the cause will not help us confirm or eliminate it as a cause. What about the gasket creates the leak? Is it too large, too small, too hard, or too soft? Saying that uneven surfaces of gaskets allow leakage suggests a different cause and, perhaps, a different fix than saying that the square corners cause the gasket to seal incorrectly.

If this search yields only implausible causes, or produces far more causes than can reasonably be evaluated in the time available, then consider distinctions and changes.

Distinctions

Number One Filter leaks; Numbers Two through Five might, but they do not. What is *distinctive* about the Number One Filter *compared with the others?* What stands out?

As the question "What is distinctive about…?" is applied to all four dimensions of a problem, our analysis begins to reveal important clues to the cause of the problem—*clues*, not answers or explanations. Let us return for a moment to the wilted potted plant in a dim corner of the office. With a basis of comparison (the identical plant that thrives on a sunny window sill), we quickly see a factor that is highly suggestive of cause. We said earlier that anyone observing this difference in treatment is likely to offer a quick opinion about the plant's wilted appearance. This natural cause-and-effect thinking pattern that we all employ ensures that we all use this kind of reasoning when confronted with a problem *provided that we observe a distinction that taps something in our experience*.

At this point in Problem Analysis, we identify the distinctions that characterize the problem in terms of WHAT, WHERE, WHEN, and EXTENT when compared with the WHAT, WHERE, WHEN, and EXTENT that *might* characterize it but do not. We will now repeat all the columns we have already developed and add a column headed What Is Distinctive About…. This is shown in Figure 5. The question we ask to elicit distinctions is this: "What is distinctive about (the IS data) when compared with (the IS NOT data)?"

The four dimensions of a specification yield distinctions of differing quantity and quality. One or more dimensions frequently yield no distinctions at all. Obviously, the goal is quality: new information that is not already in the specification and that is *truly a distinction* for only the IS.

Changes

In Figure 1, the arrowhead indicates change at a point between past acceptable performance—at which time the SHOULD was being achieved—and current unacceptable ACTUAL performance.

Managers who may never have heard of Problem Analysis know that a decline in a formerly acceptable performance suggests that something has changed; common sense tells them to look for that change. But such a search can be extremely frustrating when the manager is faced with an array of changes—changes that are known and planned, changes that are unforeseen or unknown, which continually creep into every operation.

Instead of searching through this mass of changes to find that one, elusive, problem-creating change, we examine the one, small, clearly defined area in which we can be sure of finding it: distinctions in the IS data when compared with the COULD BE but IS NOT data. This is the next step in Problem Analysis.

FIGURE 5

USE DISTINCTIONS

PROBLEM STATEMENT: Number One Filter Leaking Oil

	SPECIFYING QUESTIONS	*IS—PERFORMANCE DEVIATION*
WHAT	WHAT specific object has the deviation?	IS Number 1 Filter
	WHAT is the specific deviation?	IS leaking oil
WHERE	WHERE is the object when the deviation is observed (geographically)?	IS observed at the northeast corner of the filter house
	WHERE is the deviation on the	IS observed at the cleanout hatch object?
WHEN	WHEN was the deviation observed first (in clock and calendar time)?	IS first observed 3 days ago, at the start of the shift
	WHEN since that time has the deviation been observed? Any pattern?	IS observed continuously, on all shifts
	WHEN, in the object's history or life cycle, was the deviation first observed?	IS first observed as soon as oil goes into the filter, at the start of the shift
EXTENT	HOW MANY objects have the deviation?	IS Number 1 Filter only
	WHAT is the size of a single deviation?	IS 5-10 gallons of oil leaked per shift
	HOW MANY deviations are on each object?	N/A
	WHAT is the trend? (…in the object?) (…in the number of occurrences of the deviation?) (…in the size of the deviation?)	Stable—leaks daily, about the same amount

IS NOT—CLOSEST LOGICAL COMPARISON	*WHAT IS DISTINCTIVE ABOUT…*
COULD BE but IS NOT Numbers 2-5 Numbers 2-5?	The Number 1 Filter, when compared with *The Number 1 Filter has a square-cornered gasket; the other 4 have rounded gaskets.*
(No logical comparison)	
COULD BE but IS NOT observed at other filter locations	The northeast corner of the filter house when compared with other filter locations? *This location is nearest to the feedwater pump, exposing the Number 1 Filter to higher vibration levels than the other 4 filters.*
COULD BE but IS NOT observed at the cleanout hatches of Numbers 2-5	The cleanout hatch when compared with other cleanout hatches? *(No information not already noted above.)*
COULD BE but IS NOT observed before 3 days ago	3 days ago, at the start of the shift, when compared with the period of time before that? *There was a monthly maintenance check just prior to the start of the shift 3 days ago.*
COULD BE but IS NOT observed when the unit is not in use	Continuous leaking, on all shifts, when compared with not leaking when the unit is not in use? *Oil flows through the unit under pressure only when the filter is in use.*
COULD BE but IS NOT observed at a time later on in the shift	The start of any shift when compared with any time later on during the shift? *It's the first time oil comes into the filter under pressure. The cleanout hatch is opened and refastened daily at every shift.*
COULD BE but IS NOT Numbers 2-5	(No information not already noted above.)
COULD BE but IS NOT less than 5 or more than 10 gallons per shift	5-10 gallons of oil leaked per shift when compared with less than 5 or more than 10?
N/A	N/A
COULD BE but IS NOT increasing or decreasing in frequency or in size	N/A

What changes are most likely to suggest the cause of our problem? Those that are most relevant to its peculiar features of WHAT, WHERE, WHEN, and EXTENT. Suppose there had been eight operational and/or maintenance changes in the filter house over the past six months. Even if we knew the exact number and kind of changes that had occurred, which ones would we want to examine first? Six changes that affected all five filters? Or two that affected only the Number One Filter? Or seven that affected operations during the past six months? Or one that was instituted only a day or a week before the problem was first observed?

When we ask the following question of each distinction, "What changed in, on, around, or about this distinction?", we are going straight for the changes capable of suggesting cause. We are bypassing any changes that *may have occurred but are not relevant* to the key features of this problem. The relationship of distinctions and changes and the relationship of both to the generation of possible causes are very important.

Suppose that, when the problem was first recognized, a problem analyst had been presented with the distinction of the square-cornered gasket on the leaking filter. He or she might not have grasped its significance. Why not? Because unimportant distinctions abound between one thing and another and between one period of time and another. Compare any two pieces of equipment that have been in place for a few years and you will usually find a number of distinctive features about each. Parts have broken and been repaired. New, perhaps slightly different, parts have replaced worn-out ones. Operating procedures may vary slightly from one to the other for any of a dozen reasons.

The leaking filter might have had a different type of gasket for five years yet never have leaked until recently. *But when this distinction is appreciated as representing a change*—and a change that occurred the evening before the leaking was observed—*its significance as a clue is greatly heightened.*

To the distinctions of the IS data as compared with the IS NOT data, we now add the change question and the answers to it. This is shown in Figure 6.

FIGURE 6

USE CHANGES

PROBLEM STATEMENT: Number One Filter Leaking Oil

ABOUT…	*WHAT IS DISTINCTIVE ABOUT THIS DISTINCTION?*	*WHAT CHANGED IN, ON, AROUND, OR*
WHAT	The Number 1 Filter, when compared with Numbers 2-5?	
	The Number 1 Filter has a square-cornered gasket; the other 4 have rounded gaskets.	The square-cornered gasket is a new type, installed for the first time 3 days ago at the monthly maintenance check.
WHERE	The northeast corner of the filter house when compared with other filter locations?	
	This location is nearest to the feedwater pump, exposing the Number 1 Filter to higher vibration levels than the other 4 filters.	Nothing. Location and vibration levels have been the same for years.
	The cleanout hatch when compared with other cleanout hatches?	
	(No information not already noted above.)	
WHEN	3 days ago, at the start of the shift, when compared with the period of time before that?	
	There was a monthly maintenance check just prior to the start of the shift 3 days ago.	A new type of square-cornered gasket was installed for the first time 3 days ago, as noted above.
	Continuous leaking, on all shifts, when compared with not leaking when the unit is not in use?	
	Oil flows through the unit under pressure only when the filter is in use.	Nothing.
	The start of any shift when compared with any time later on during the shift?	
	It's the first time oil comes into the filter under pressure. The cleanout hatch is opened and refastened daily at every shift.	Nothing. Nothing. The filter has been cleaned, hatch refastened on every shift for years.
EXTENT	(No information not already noted above.)	N/A
	5-10 gallons of oil leaked per shift when compared with less than 5 or more than 10?	Nothing.
	N/A	N/A
	N/A	N/A

Somewhere in the distinctions and changes that emerge during Problem Analysis lies the explanation of cause—provided that all relevant information about the problem has been obtained and included. Several possible causes will sometimes emerge. In some cases, pieces of information must be knitted together to provide a satisfactory explanation of the problem's cause. Two changes operating in combination may produce a performance deviation that one of those changes alone cannot.

We identify possible causes by asking the following question of each item in the categories of distinctions and changes: "How could this distinction (or this change) have produced the deviation described in the problem statement?" Again, as with using knowledge and experience, it is necessary to develop statements that explain how the cause creates the deviation. Beginning at the top of Figure 6—distinctions and changes relative to WHAT—we immediately notice the combination of a distinction and a change:

> **Possible Cause:** The square-cornered gasket (a distinction between the Number One Filter and the other four) from the new supplier (a change represented in that distinction) is too thin and unevenly constructed. This caused the Number One Filter to leak oil.

Other possible causes can be generated from the distinctions and changes in our analysis. Knowing the true cause, they will not appear to be strong contenders, but they are possible. We will describe them in order to help explain the testing step of Problem Analysis in the following section.

One possible cause can be derived from the WHERE dimension. It was noted that the northeast corner of the filter house, where the Number One Filter stands, contains the feedwater pump. This distinction has some significance: The leaking filter is exposed to considerably greater vibration than the other four filters. This represents no change. It has always been that way. We know from the specification, moreover, that the current leakage is occurring at the cleanout hatch, not at the valves. When vibration caused leakage in the past, it occurred at the valves. Nevertheless, at this point in Problem Analysis, we should generate all reasonable possible causes, without focusing only on the problem's true cause. Vibration is given the benefit of the doubt.

Possible Cause: Vibration from the feedwater pump in the northeast corner of the filter house (distinction in the dimension of WHERE) causes the Number One Filter to leak oil.

TEST POSSIBLE CAUSES AGAINST THE SPECIFICATION

The last statement is listed as a possible cause simply because it is possible. That's important. By including *all* possible causes, we lose nothing, maintain our objectivity, and reduce the incidence of conflict and disagreement in the explanation of a problem. In the testing step of Problem Analysis, we let the facts in the specification perform the function of judging the relative likelihood of possible causes.

We ask of each possible cause, "*If* this is the true cause of the problem, then how does it explain each dimension in the specification?" The true cause must explain each and every aspect of the deviation, since the true cause created the *exact* effect we have specified. Effects are specific, not general. Testing for cause is a process of matching the details of a postulated cause with the details of an observed effect to see whether that cause could have produced that effect. For example:

If vibration from the feedwater pump is the true cause of the Number One Filter leaking oil, **then** how does it explain **why**:

WHERE: Leaking IS observed at the cleanout hatch; IS NOT observed at the cleanout hatches of Numbers Two through Five.

WHEN: Leaking IS observed three days ago; IS NOT observed before three days ago.

Vibration previously affected the valves and *not* the cleanout hatch. It doesn't make sense to say that vibration causes a cleanout hatch to leak. Why would vibration cause leaking to begin three days ago and not before? Unless we are willing to make some rather broad assumptions, we cannot make this possible cause fit the observed effects. Our judgment tells us that this is an improbable explanation at best.

Another possible cause is suggested by the distinctions and changes found in our analysis:

Possible Cause: New maintenance people (a distinction that also represents a change in the WHEN dimension) are not using a torque wrench to close the cleanout hatch. This is causing the Number One Filter to leak.

Testing this possible cause with our "If. . .then. . ." question, we quickly find ourselves at a loss to explain why the leaking occurs only on the Number One filter and not on the other four. After all, the same people are responsible for maintaining all five filters. If they failed to use a torque wrench on the Number One Filter, why would they do so on all the others? We would have to make broad assumptions to make the cause fit the observed effects: "Well, they probably use the torque wrench on the other four. But back in the northeast corner of the filter house, where it's so dark and there's all that vibration from the feedwater pump, they choose to forget it and don't tighten the cleanout hatch the way they should." This explanation is more improbable than the other one.

The actual cause fits all the details of the effect as specified: a new, thinner, square-cornered gasket that was put on the Number One Filter three days ago during the monthly maintenance check. It explains the WHAT, WERE, WHEN, and EXTENT information. It requires no assumptions at all to make it work. It fits as hand does to glove, as cause and effect *must* fit. There is less likelihood of the other possible causes being true.

DETERMINE THE MOST PROBABLE CAUSE

By now in our analysis, we will have identified *the most likely possible cause* that explains the deviation better than any of the other possible causes. But this most likely possible cause seldom proves to be, beyond the shadow of a doubt, the true cause. Of course this is not always the case. Often, several possible causes, including the true cause, carry assumptions that must be true if the cause is to be true. We compare assumptions by asking "Which cause has the fewest assumptions? Which cause has the most reasonable assumptions? Which cause has the simplest assumptions?" Our selection of the most probable cause may depend as much on the quality of the assumptions as on the quantity. Sometimes judgment is needed to select the most probable cause. To improve our chances of success, however, we need to spend time and effort in confirming the cause.

VERIFY ASSUMPTIONS, OBSERVE, EXPERIMENT, OR TRY A FIX AND MONITOR

Confirmation is an independent step taken to prove a cause-and-effect relationship. It depends on bringing in *additional information* and taking *additional actions*.

To *confirm* a likely cause is to *prove* that it did produce the observed effect. In our example all we need to do is simply look at the gasket in operation and see whether it leaks (observe). Or, we can trade the gasket from the Number One Filter for the non-leaking gasket from one of the other filters (experiment). Or, we can obtain a gasket with rounded corners from the old supplier, install it, and see whether the leaking stops (try a fix and monitor). Any of these would prove that the leaking resulted from the installation of a new, thinner, square-cornered gasket bought at a bargain price.

Sometimes no *direct confirmation* is possible and we must rely on our assumptions. A rocket booster explodes in flight. Most of the tangible evidence is destroyed. We would certainly not want a second such accident. All that can be done is to verify assumptions generated during the testing against the specification. “If *this* happened, then *that* would make sense….” Devise ways to verify the assumptions. The assumptions must be true in order for the cause to be true.

Confirmation is possible in most problem situations. What it consists of will depend on the circumstances. We want to use the safest, surest, cheapest, easiest, quickest method. A mechanical problem may be duplicated by consciously introducing a distinction or a change that seems highly indicative of cause. Many problems are confirmed by “putting on the old gasket”—that is, reversing a change to see whether the problem stops (try a fix and monitor). In that case, confirmation provides corrective action. Resolution coincides with the last step in the process of Problem Analysis.

Failure

Of course, we may fail. While the most common cause of failure is too little data in the specification, there are three other major reasons for failing to solve a problem despite using Problem Analysis:

- ➢ Using inaccurate or vague information to describe the problem.
- ➢ Insufficiently identifying key distinctions and changes related to the IS data in the specification.
- ➢ Allowing assumptions to distort judgment during the testing step. The greater the number of assumptions we tack onto a possible cause in order to label it "most probable," the less chance there is that it will survive confirmation. There is nothing wrong with making assumptions as long as we regard them as such and do not prematurely grant them the status of fact.

A Process, Not a Panacea

Thousands of people have used these techniques to solve problems that seemed otherwise unsolvable or solvable only by far greater expenditure of time and money. On the other hand, many of these same people have failed to solve other problems they were sure they could crack—"if only they had stayed with the process." Problem Analysis enables us to do a good job of gathering and evaluating information about problems. However, there are limitations to the power of the process to produce the right answers. If we cannot track down the key facts needed to crack a problem, that problem will continue to defy solution. No approach or process, however systematically or meticulously applied, will unlock its secret.

Chapter Summary

The shadows cast by our problems may be perplexing. Yet the *structure* of *all* problems is always the same. It is knowledge of this structure that enables us to move systematically from definition to description to evaluation to hypothesis to confirmation of cause.

- The **Problem Statement** is a concise description of both the object of our concern and the deviation or malfunction for which we want to find the cause. In our example, that statement was "Number One Filter Leaking Oil."
- The **Specification** of the problem is a comprehensive description of the problem's WHAT, WHERE, WHEN, and EXTENT—as it IS and as it COULD BE but IS NOT. The Number One Filter IS leaking; each of the other four COULD BE but IS NOT. The location of the leak IS the cleanout hatch; the leak COULD BE but IS NOT observed at the cleanout hatches of Numbers Two through Five. From the identification of this IS… COULD BE but IS NOT data, we assemble bases of comparison that will lead us to an understanding and resolution of the problem.
- Our own **Knowledge** and **Experience**, or that of experts, may suggest possible causes. Using the specification as a guide, we look to generate as many possible causes as we reasonably can. We then test these against the specification.
- If we have too many or too few causes to consider, or if all of the causes we generate fail to test against the specification, we look for **Distinctions**—features in all four dimensions that characterize only the IS data. We ask, "What is distinctive about the Number One Filter when compared with Filters Two through Five?" We carry this kind of questioning through the other three dimensions. The result is a collection of key features that characterize the WHAT, WHERE, WHEN, and EXTENT of our problem.
- We then study each distinction to determine whether it also represents a **Change**. It is at this point in our analysis that we recognize the square-cornered gasket on the leaking filter—not only as a distinctive feature of that filter but also as a change. Until the day before the problem appeared, the Number One Filter had been equipped with the same type of round-cornered gasket used on the other units.
- When all the distinctions and changes have been identified, we begin to **Identify Possible Causes**. Each distinction and change is examined for clues to cause. Each resultant hypothesis of cause

is stated to illustrate not only what caused the problem but how it did so: "The square-cornered gasket from the new supplier is too thin and unevenly constructed. This caused the Number One Filter to leak."

- ➢ Each possible cause we generate is then **Tested** against the specification. It must explain both the IS and IS NOT data in each dimension. To graduate to the status of **Most Probable Cause**, it must explain or withstand all the facts in the specification. Unless we make some farfetched assumptions, "greater vibration in the northeast corner of the filter house," for example, cannot explain either the leak at the location on the filter or the time period that characterized this problem. Vibration, as a possible cause, is less likely to have produced the problem than the installation of the new gasket.
- ➢ The final step in Problem Analysis is **Confirmation** of the true cause. We are hoping to demonstrate, as closely as possible, the cause-and-effect relationship. The confirmation is carried out in the work environment if possible. In our example, this can be done either by duplicating the effect suggested by the cause or by reversing the change suspected of having caused the problem to see if the problem stops.

If no possible cause that has been generated passes the testing step, or if no cause that does pass it survives the confirmation step, the only recourse is to tighten up the prior work. We may need more detailed information in the specification, in the ensuing identification of distinctions of the IS data, and in the identification of changes in and around the distinctions. This may lead to new insights, to the generation of new possible causes, and, finally, to a successful resolution.

If we fail to find the true cause of a problem through these techniques, it is because we failed to gather and use information appropriately. We cannot use information that we do not have. If we get the information but use it carelessly, the result may be no better.

The logic of Problem Analysis defends conclusions that support facts; it sets aside those that cannot. It is a process that makes use of every bit of experience and judgment we possess; it helps us to use both in the most systematic and objective way possible.

Problem Analysis enables people to work together as a team, pooling their information in a common format, to determine the cause of a problem. Most deviations are so complex that one person alone does not have the information necessary to find, test, and confirm the cause. When all those who hold important data have a mechanism for integrating it, they can begin to find the unknown cause. Otherwise, that discovery may be stalled by misunderstandings and other barriers to communication.

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