1. Background

1.6. Group Decision Making

1.6.1. Matched Decisions (Two)

1.6.1.1. COMMUNICATING BETWEEN DOMAINS.

We communicate between two domains by linking information flows at the information-portrayal-to-information-perception interfaces of the two domains.

When we focus on the Management System Model (MSM), we're considering one domain with one decision maker (who manages.) Obviously we've made a simplifying assumption when we think the domain has no interactions with its environment. We assume our domain of responsibility is operating as an island of management, as a closed system.

Now we'll consider one type of interaction between one domain and another. The types we won't consider now are those where our domain sends information to another domain for their independent decision making or where our domain receives information from another domain for our independent decision making. The type we'll consider is the one where our domain and another must pass information back and forth so the decision makers of both domains can make decisions leading to a mutual outcome. This mutual outcome is a single action affecting both domains. Such decisions I call matched decisions because one without the other is necessary but isn't sufficient to achieve the desired mutual outcome.

You can think of a number of situations where you must receive a decision from another domain to match your own decision for you to get the result you want. Consider the situation of choosing a mate—the marriage problem. How about choosing a college? You'll soon be looking for a job. You'll want the company you most want to work for to want you most also. If you want them but they don't want you, you won't go to work for them. If they want you but you don't want them, you also won't go to work for them. So, for you to go to work for them, both you and the company must make a matched decision. And you must make your mutual decisions at exactly the same time. Timing is important. I've seen a situation where Sally wanted to marry Bill but Bill was marrying Paula. After Bill and Paula were divorced, Bill wanted to marry Sally, but Sally had married Harry. It's fascinating how matches are made. I'll add another example we at the university worry about all the time. Both the researcher and the sponsor must come to a mutual decision at the same time or we don't get a research contract.

Operations researchers study this problem mathematically. One specific application they consider is the secretary problem. The generalized problem is called optimal selection and assignment. Operations researchers look for situations to optimize numbers of applicants to numbers of selectors. They look for stable and optimal situations. In choosing a college, an assignment of applicants to colleges is called unstable if, for example, there are two applicants Mary and George who are accepted by the University of Virginia and Virginia Tech, respectively, although George prefers UVA and Mary prefers Tech. A stable assignment is called optimal if every applicant is at least as well off under it as under any other stable assignment. Believe it or not, the operations researchers find that there always exists a stable set of marriages. But they're looking at large numbers of applicants and selectors.

We're interested in individual pairs of domains. That is, given a company and a college graduate, what information must be passed in each direction and how do we pass the information to find a match, where the only match we want is a stable one. In Figure 1.6.1.1., I show two isolated domains sharing a hiring decision.

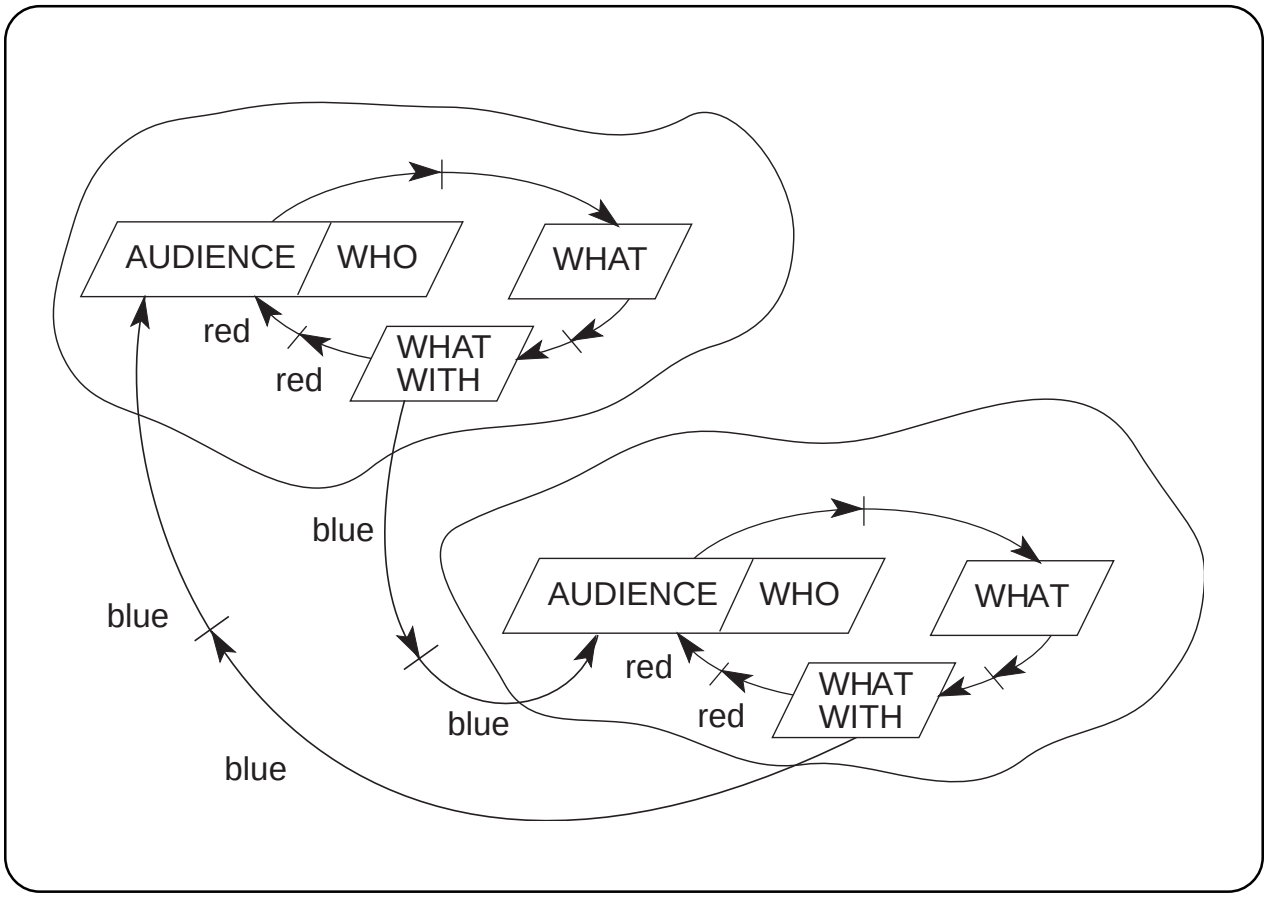

Figure 1.6.1.1. *Two domains are joined at their information portrayal/information perception interfaces.*

1.6.1.2. THE HIRING DECISION.

Like a marriage decision, when a hiring decision is made, two domains must exchange information and make a pair of compatible decisions.

Let's concentrate for a moment on the domain of responsibility of you, the student, in Figure 1.6.1.2. Of course, you use the management tools in your domain to portray information. But, portray information to whom? In this case, you can portray information either to you, the who manages of your domain, or to the recruiter, the who manages of XYZ company. Remember, we design information portrayals based on the equation: Purpose plus audience equals design. So, we want to portray information about our desires, needs, abilities, preferences, and transferrable skills to ourselves—within our own domain. We also want to portray similar information to the recruiter. Note, however, that the audiences (the different who manages of the two domains in the figure) are certainly different and the purpose could very likely be different. Therefore, the design should be different. I'll argue, by the way, that the purpose should be the same—that is, to make a stable match.

Since the portrayal design should be different for the two domains, should you design your resume to fit the audience represented by the recruiter? Yes. The recruiter is the person whom you want a given action from. What action? The appropriate action to want in the recruiting process is the setting up of another information portrayal. That is, you want the recruiter, based on the information in your resume, to decide to invite you to a job interview.

How about the other audience in Figure 1.6.1.2.—you. You use the resume to accurately display what you like to do, are good at doing, and want to do. I believe you should want your resume to honestly portray your transferrable skills you believe can help the company you've decided you really want to work for. You'll decide you want to work for that company based on an entirely different set of information portrayals. The information portrayals you'll use to decide you want to work for XYZ company are from the company, either directly designed for recruiting or indirectly from the library, a friend who works for the company, or other information.

Perhaps you need two resumes. One for the recruiter and one for you. Remember, the audiences are different.

Let's look at some separate information portrayals you might produce from your management tools to serve your desire to find the right company to work for. These separate information portrayals include the resume, interview, plant trip, letters, telephone calls, and potentially many others. Yes, letters and telephone calls are information portrayals, although often they include portrayals both by you and by the company. So, each portrayal should be designed by you to address the right audience and to meet the right purpose.

Don't forget, in addition to concentrating on information you portray to get the right decision from the recruiter, you must also concentrate on getting (having portrayed and perceiving) information from the company to get the right decision from you. Don't get caught up in the chase of getting the company to love you and make the mistake of going to work for a company you'll hate. (The parallel with getting a matched decision in choosing a mate as

we discussed earlier is valid here also.)

Each information portrayal should have one and only one purpose. For example, single-purpose, decision-related information portrayals should help me make my point. The resume is an information portrayal designed to get a decision and action for an interview. The interview—at least the kind you'll have on campus—should have the single purpose of getting a plant trip. The plant trip includes almost all information portrayal, and focuses on the decision and action of a job offer. Even then, we won't have a match. Based on the information in the job offer (salary, benefits, and other information), you'll need to decide if, indeed, you have a match and will accept or decline the offer.

Be sure you focus on the purpose the portrayal should be designed to meet. Don't think your resume is designed to get the action of getting hired. If you did that, you'd be admitting it's all right if the company hires you sight unseen.

In addition to asking, "What information should I portray about myself?" another question you should ask is, "What information should I seek about the company?" The answer to the first question is: Portray information about the transferrable skills you have and the company needs, and use your experience and attributes to lend confidence to both you and the company you have these skills and the skills are transferrable. (The only reason for a long resume is to show you've repeatedly transferred the skills the company is hoping you'll transfer to them.)

We'll address the question of what to look for in a company when, later in the semester, we discuss organizational culture. Organizational culture is about shared values. Most of all, you'll want to know how your values match up with the company you're considering. That means you'll have to figure out what your values are and the importance of finding a company that shares your values.

Finally, I'll mention a key issue in designing an information portrayal after you've figured out the audience and the purpose. That issue is: When you know what the key information is you want to portray, put the information where the audience will find it immediately.

Think about the information portrayals you hear or see. How long do they hold your attention. I'll bet not very long. Soon after the sounds or sights of the information portrayal begin, your mind wanders. And not very long after that, you either put what you're reading down or walk away from whom you're listening to. But, wait a minute. The information portrayer is saving the best for last. Too late. You're either mentally or physically gone. If you do these things, you can bet your audience does too.

The bottom line is: Put the important stuff, all of it, where the audience (the perceiver—who manages) will see it first and condense that important stuff so the audience gets it before he or she abandons you. And one place people usually look or listen first is at the beginning. So, put the bottom line on top.

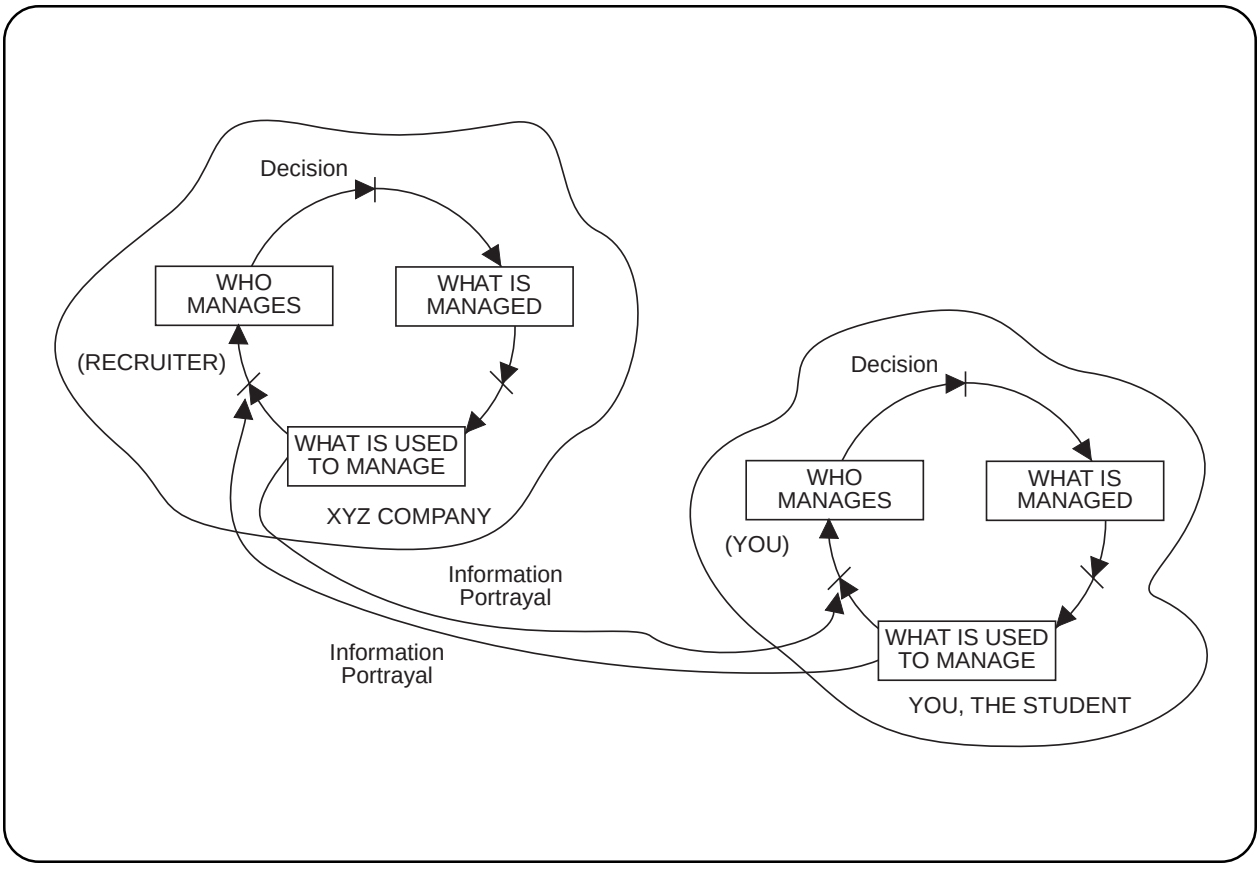

Figure 1.6.1.2. *To make a matched decision, you must exercise the red loop, blue loop information transfers extensively.*

1.6.1.3. THE LESSONS-LEARNED SHARING PROCESS.

When we share information between domains of responsibility about what we learn in one of the domains, we're linking the Management System Model and the Plan-Do-Study-Act Cycle.

When you make decisions (manage) about your work process (what is managed), you want to observe the effects of the action you take. Your observation is the information gathering part of the Plan-Do-Study-Act (PDSA) Cycle. After you act on what you plan to do, you study what happened to see the effect of that action. You can share your actions and the resulting effects with someone with a similar domain of responsibility.

A good example of similar domains is two different shifts in a manufacturing plant. Consider Domain A to be Shift I in a manufacturing plant and Domain B to be Shift II. The machines are usually the same between shifts, but are the work processes the same between shifts? No, because, by definition, the people involved in the work process change between shifts. Also the decision maker may change and so may the management tools.

In Figure 1.6.1.3.1., I show two different domains as two sequential shifts. I show each domain as a PDSA Cycle because I want to get at the lesson learned out of the Study step of the PDSA Cycle of shift I to share with shift II. The sharing process shares lessons learned from one cycle's Study step to the other cycle's Plan step. Each cycle can represent a work shift or a project, with the shift or project beginning with the Plan step.

In Figure 1.6.1.3.2., I show the two different domains as two Management System Models. I've shown the what is managed components as tasks and the what is used to manage components as organizational memory. As we convert data to information in the management tools, we have the opportunity to remember the information. Since the management tools gather data about the work process and the effects of the manager's decisions and actions on the work process, the memory is organizational.

In Figure 1.6.1.3.2., I use the notation {domain, cycle} to distinguish the components and interfaces of the two different domains and cycles. I'll illustrate the cycles in Figure 1.6.1.3.2. The first cycle begins with a decision in Domain A and ends with the update of the organizational memory in Domain A. The first who manages {A} during the first cycle {c1} makes a decision {A, c1} that leads to an action {A, c1} on a task {A, c1}, all within the first cycle {c1}. Measurement {A, c1} on the task performance produces data {A, c1}. The second cycle {c2} begins with the updating of organizational memory. Organizational memory is updated with a lesson learned.

The contents of organizational memory at the beginning of cycle {c2} are shared between management domains {A} and {B}. The information portrayal of both domains {A} and {B} at the beginning of the second cycle {c2} is a set of lessons learned in domain {A} to be shared with domain {B} and , therefore, is the same for each domain. The second cycle begins when the second who manages {B} uses this information {B, c2} to make a decision {B, c2} leading to an action {B, c2}. The action on task {B, c2} produces a lesson learned

through measurement and data. Organizational memory is updated to represent its new state at the beginning of the third cycle {c3}.

The lessons-learned sharing process to support organizational learning is best seen in the sine-wave representation of the Management System Model described in Figure 1.1.18.3. The sine-wave representation is repeated in Figure 1.6.1.3.3. to emphasize the cycles illustrated in Figure 1.6.1.3.2. The functions of the lessons-learned sharing process are: 1) the problem-solving or learning experience, 2) the storage and refinement of data, 3) the conversion of data to information and the updating of the organizational memory, and 4) the retrieval and interpretation of information. One repetition on the lessons-learned sharing process overlays one loop from one learning experience to the next represented as sequential what is managed components of the Management System Model.

The understanding of the lessons-learned sharing process and the linkage between the Management System Model and the Plan-Do-Study-Act Cycle was developed during my collaboration with Tim Kotnour on his Ph.D. dissertation. (Timothy G. Kotnour, "The Effect of Lessons-learned Sharing Processes for Organizational Learning on Decision-making Performance," Unpublished Ph.D. dissertation, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, pp. 6-8.)

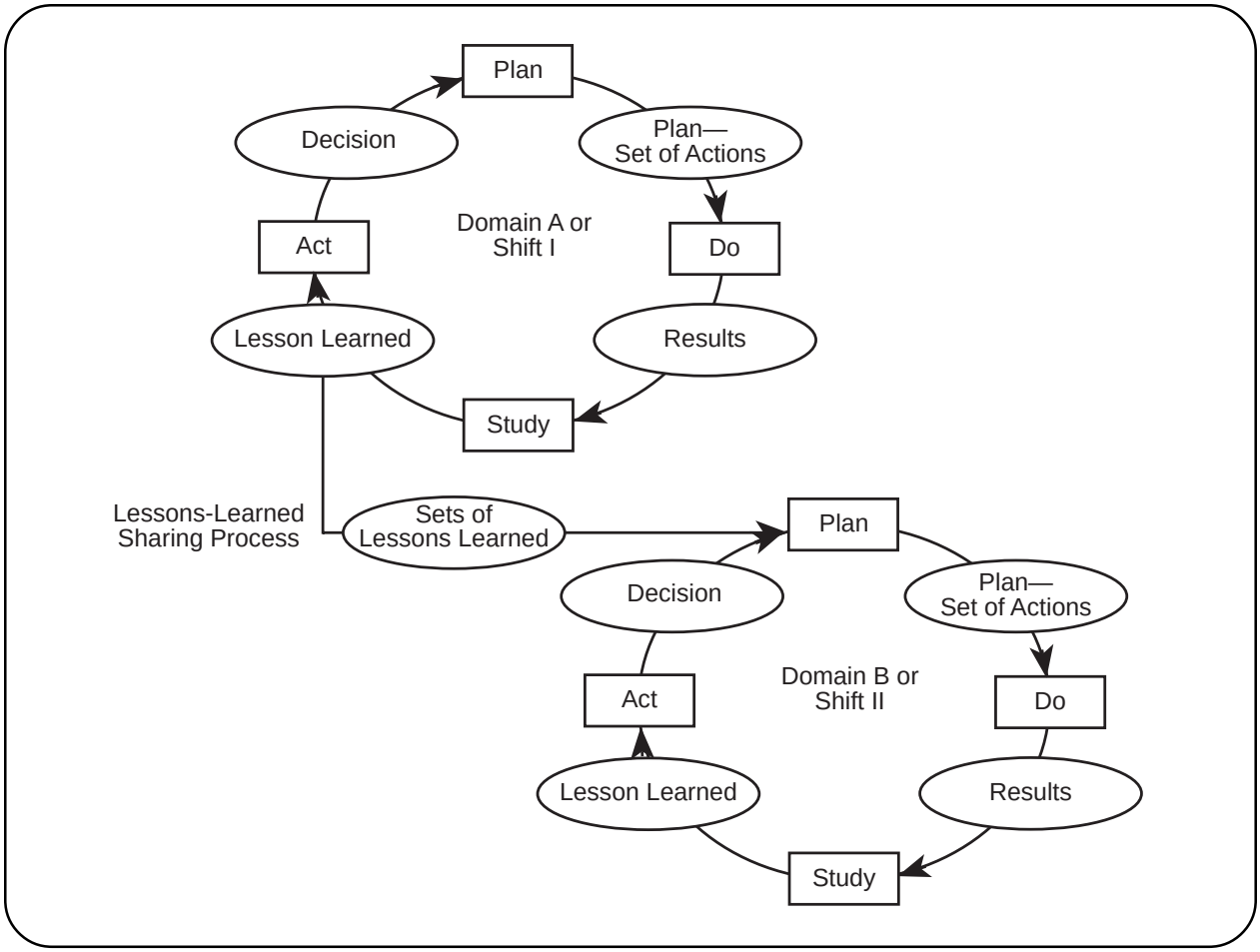

Figure 1.6.1.3.1. *One domain shares a lesson learned with another domain when information about the effects of an action is shared.*

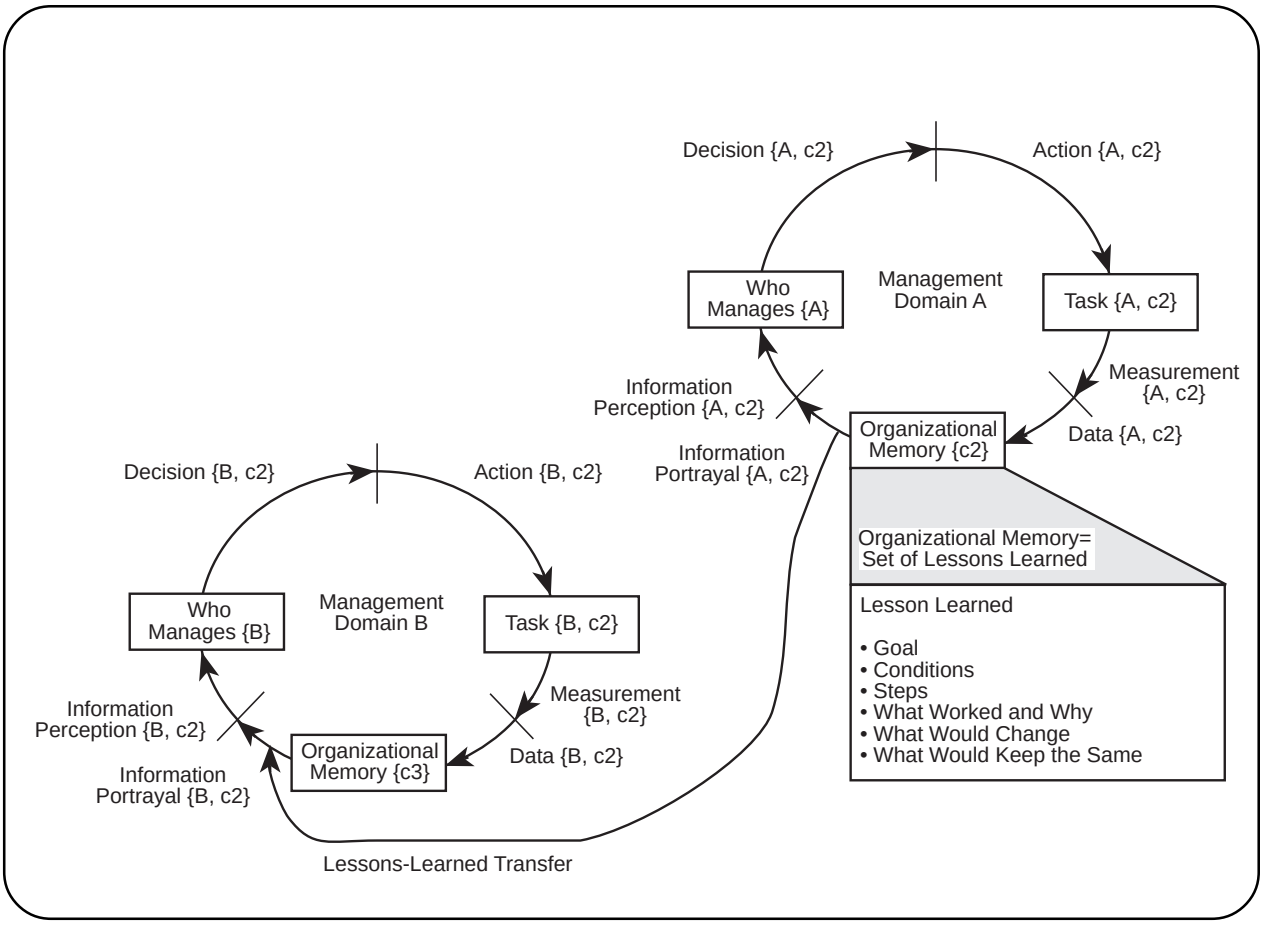

Figure 1.6.1.3.2. *The lesson learned is shared when the organizational memories of both domains are updated.*

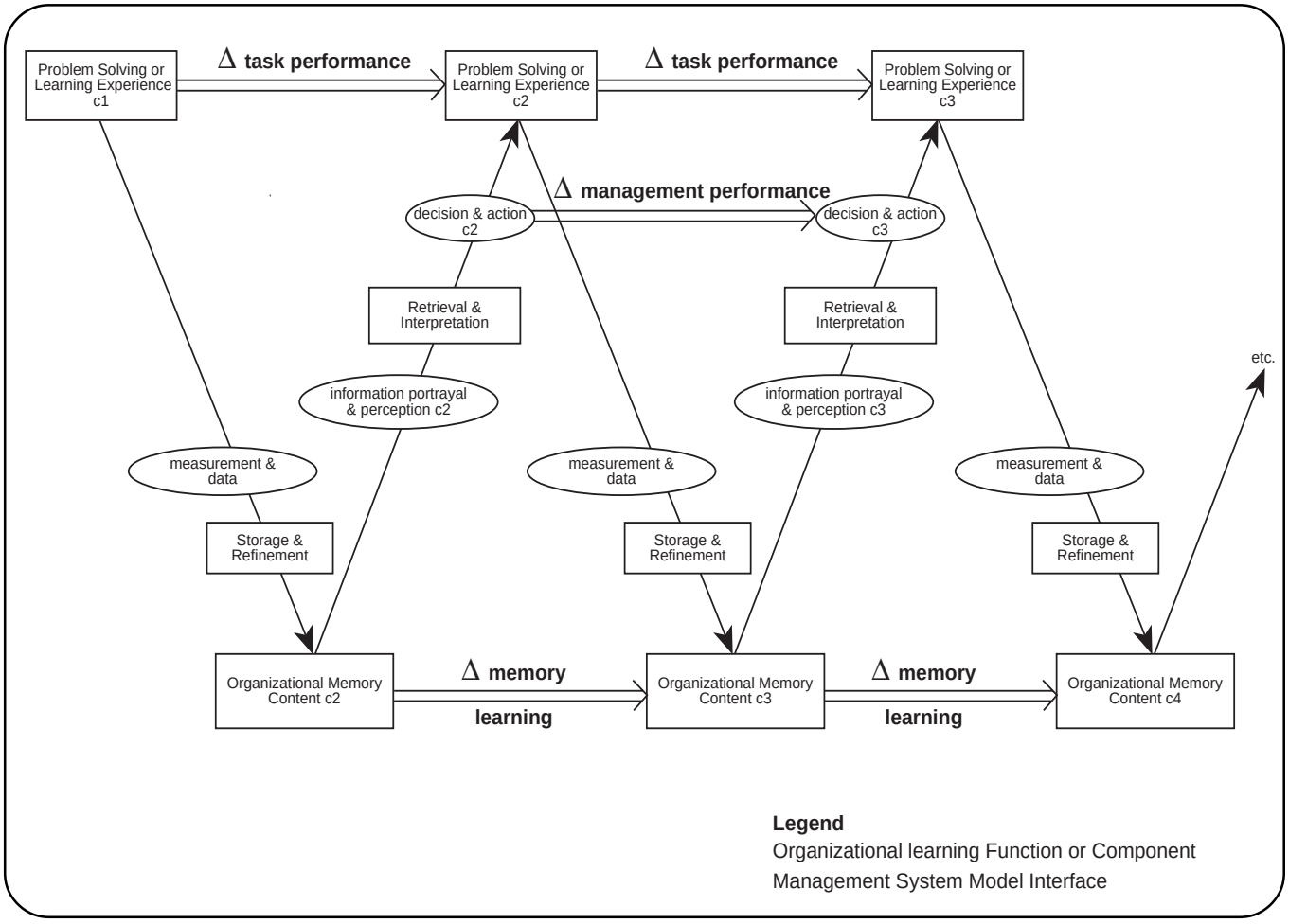

Figure 1.6.1.3.3. *The sine-wave representation of the Management System Model shows a number of sequential lessons-learned sharing process cycles.*

1. Background

1.6. Group Decision Making

1.6.2. Group Decisions (More than Two)

1.6.2.1. Information Sharing

1.6.2.1.1. SHARING INFORMATION—JOHN CONSTABLE

1.6.2.1.2. SHARING APPLIED TO SHARED INFORMATION PROCESSING

Sharing presents several dilemmas as we work with data and information.

How can informal communication be shared without turning it into formal communication? How do we prevent computer crime—or the unwarranted distribution of confidential data and information—without making it unreasonably hard on the people who should have access (Littman, 1984)? How do we deal with what we call the Dilemma of Protection: the problem of unnecessary *protection* of data versus counterproductive *hoarding*?

The word *share* comes from a root that means both to join and to separate. This paradox leads us to the correct assumption that understanding and dealing with sharing isn't simple. Sharing is borrowing, or taking from someone. Sharing is lending, or giving to someone. Sharing is dividing something that can be divided and then giving or lending part and keeping the rest. And then there's *not* sharing—deliberately protecting or hoarding data and information. We spoke of the Dilemma of Protection. Here we have a similar but distinct case—sharing with some while hoarding from others—which is the source of a second dilemma of shared information processing, the Dilemma of Hoarding: the harder you work to hoard what you want to hoard, the harder it is to share what you want to share.

Shared information processing can be good or bad. It's good when the result is everyone singing off the same sheet of music. It's bad when data and information are abused—stolen, for example, or incorrectly changed. We need to understand and implement shared information processing to maximize the good and minimize the bad.

Kreckel (1982) classifies communication as a form of sharing—sharing information. Lindenberg (1982) notes three dimensions of sharing. The first distinguishes whether the shared goods are public (parks, streets, communication lines) or private (lawn mowers, cars, terminals); the second whether the shared goods are instrumental (time, money, data) or directly usable (cookies, clothing, information); and the third whether the shared goods are divisible (candy, databases) or indivisible (books, printers).

Let's classify the sharing of corporate data, one factor of shared information processing, in terms of the three dimensions. Corporate data is a public good, as we define it, being shared by a group of people—the members of the organization. Since data are converted into information, and this information is processed for use in making decisions, corporate data are instrumental. More specifically, corporate data are instrumental when used for decision making. When they are used to gain or maintain power by being protected or hoarded, corporate data are used not instrumentally but against corporate empowerment goals. We generally treat corporate data as being indivisible, because access is given to groups of data, not to just the specific data items needed. (Although databases are often partitioned, the user sees a group of data, even though it may not be the full body of data.)

Corporate data, then are public, instrumental, and indivisible—at least among an organization's insider network. But corporate data carries a twist not exposed by our classification: while corporate data are generally indivisible, the data used can be changed without other sharers being aware of the change. When you share your lawn mower or your tuxedo with a neighbor, you can usually tell if

it is returned in its original condition. But when you pull data out of a database, change them, and then replace the original data with the revised data, other users will not as easily notice the changes.

A third dilemma, the Commons Dilemma (Hardin, 1968), an example of sharing studied 25 years ago, is pertinent to shared information processing. This dilemma pits an individual's short-term consumption against a group's long-term conservation. The name of this dilemma comes from the New World settlers' designation of a common grazing area for their cattle, as had been the custom in England. The common resource was depleted as each farmer sought to increase his own herd. This dilemma appears in shared information processing. Managing the integrity of your own data that only you have access to is not particularly difficult. But problems arise when a group of people makes updates on the same database. How do we know if the data retrieved are accurate? How do we know whether or not they are ready for release?

1.6.2.1.3. THE FORCING FUNCTION FOR SHARING

No matter how hard it is to do, we must share data, information, decision mechanisms, and information processors.

There are three forcing functions for sharing, and all three are related: rapidly accelerating technology, the rising popular emphasis on participative management (due to society's desire to be part of major decisions as the world becomes an electronic global village, shared through networks of computers, televisions, and radios), and the public's, as well as the Congress's demand that we run a tighter economic ship and work smarter and leaner. We must, now that we seem technologically capable of it, convert from slack management to effective management. No longer can we solve problems by throwing more money at them in hopes they'll go away. No longer can we let huge inventories of materials, people, and equipment mask—or rather, demonstrate—our collective national inability to manage.

We have technologized compatibility. We have higher processing speed, more users, more data and information to deal with. We have not only word processing but voice and image processing. We have networks—local, national, and international. And along with all this revolutionary hardware and software we have the manager's strong desire, even demand, that the technology add up to something big, something good: increased productivity for organizational units; improved performance for the organization as a whole.

More complex technologies lead to greater specialization within organizations. Therefore, these specialized groups need to coordinate and communicate with each other more than ever before. "Interdependence is a central characteristic of the modern, complex society. . . We have learned that we can have more of everything we want by specializing individually. However, the price of specialization is dependence on others" (McGregor, 1960). Our interdependence forces shared information processing.

Participative management is a further result of the interdependence McGregor underlines. Technology says we have no choice but to be interdependent. Once we listen to what technology says, and start to figure out how to manage our interdependence, we discover that we really *like* sharing: we discover that the more often we can be heard where it counts, the more we count, the more we matter.

Shared information processing is not a new concept. But because of the three forcing functions, as never before we need technologies for effectively managing this sharing. We don't restrict the concept of "technologies" to mean only computers, distributed databases, and other computer devices. We understand and use the term broadly, like anthropologists, who define technology as "controlling nature and taming it to human purposes" (Newman, 1971), or "how people use skills and knowledge to make things" (Howard, 1986). This broad definition includes but is not limited to technologies for sharing information in decision making, sharing data and information for strategic planning, and implementation technologies for shared information processing.

Problems with Shared Information Processing

Several researchers are working on the problems of distributed processing and the sharing of corporate data (Berstein et al., 1978; Garci-Molina, 1978; Kohler, 1981; Watson and

Fletcher, 1979). Walter Kohler, professor of computer and electrical engineering at the University of Massachusetts and pioneer researcher in distributed processing systems, voices the need for more research in shared information processing. He says information processing is in transition. "We haven't wrestled with the issue of shared systems." He claims researchers are using primitive sharing models. He further states the solutions generated are technical, but the problem of sharing data and information is general, therefore requiring more general research (Kohler, 1986). By including the sociological and psychological aspects of sharing, we can approach sharing data from precisely this broader shared-information-processing perspective. Following are three examples of shared-information-processing problems. These three are not the only ones (Rothnie et al. 1980). Attention must be paid to distributed query processing which corresponds to the "execute" phase of a distributed processing system.

Concurrency Control

Berstein and Goodman (1981) define concurrency control as "the activity of coordinating concurrent accesses to a database in a multiuser distributed DBMS. Concurrency control permits users to access a database in a multiprogrammed fashion while preserving the illusion that each user is executing alone on a dedicated system. The main technical difficulty in attaining this goal is to prevent database updates performed by one user from interfering with database retrievals and updates performed by another." Distributed Data Base Management Systems (DBMS's) create problems besides concurrency control since (1) in a distributed system, users may access data stored in many different computers, and (2) one computer's concurrency control mechanism cannot instantaneously know about interactions at other computers. Concurrency control in distributed DBMS's was and remains "in a state of extreme turbulence" (Bernstein and Goodman, 1981; Kohler, 1986).

Lack of Responsiveness

Solotruk and Kristofic (1980) say user adaptability should be built into information systems. They claim lack of adaptability will lead to lower information systems quality. Responsive systems (adaptive, adaptable, flexible, and custom-fit) deal with adaptability.

Data Security

Shared data poses an additional problem of security. Not all members of the organization owning the data should have access to all the data. There need to be procedures and techniques for managing data access. Roos (1981) suggests users in a data sharing environment should draw up a very clear set of agreements about data usage authority.

The security problem increases exponentially in an environment containing classified data and information. Most people in such environments need routine access to *both* classified and unclassified data and information. But the two kinds cannot be stored together for easy access, nor can they both be processed on the same equipment. Again we have the Dilemma of Protection: everything we do to make data more secure also makes it harder to share.

1.6.2.1.4. THE ALTERNATIVES FOR SHARING

We can share data and information better either by decreasing the need for it or by increasing our capacity for doing it.

Design of Responsive Systems
Consider four stages of responsiveness—adaptive, adaptable, flexible, and custom-fit. Adaptive systems are futuristic. They'll adjust their menus and help-routines based on the user's knowledge or experience as monitored or sensed by the system. Adaptable systems can adjust to who manages when they are told about who manages. Flexible systems provide a series (large or small) of fixed alternatives from which the user can select. Today's responsive systems are mostly custom-fit, at great cost both of time and money, and don't perform well in a shared information processing environment.

Organizational Design Strategies
Information processing can be managed through organizational design strategies. Galbraith (1973) notes that when an organization's hierarchy is overloaded because of the frequency of exceptions the "organization must employ new design strategies." Galbraith continues, "the organization can either act in two ways to reduce the amount of information that is processed, or it can act in two ways to increase its capacity to handle more information." The strategies obviously extrapolate to shared information processing, as shown in Figure 1.6.2.1.4.

The first two ways are "creation of slack resources" (reducing the required level of performance by increasing schedule time or person-hours) and "creation of self-contained tasks" (giving "each group...all the resources it needs to perform its task"). These two ways, Galbraith observes, "reduce the need for information processing." They also reduce the need for sharing, but at high (these days, prohibitively high) cost. Government organizations, for example, tend to decentralize into rather independent field offices meeting Galbraith's criteria for creating self-contained tasks. Government organizations also tend to achieve management "efficiency" by meeting Galbraith's criteria for creating slack resources. They create slack in the dimensions of time (slipped milestones or schedules rarely have dramatic negative consequences), material inventories (in-process inventories are the norm), personnel, dollars, and . . . information! Government organizations are so used to operating off slack, they produce extra information just for the sake of having it in case they need it. The result of this in-process information inventory is information overload and consequent muddling of decision processes. Government organizations act to reduce the need for shared information processing rather than increase the capacity for it.

The second two design strategies, "investment in vertical information systems" and the "creation of lateral relations," both "increase the capacity to process information" and also increase the capacity for sharing. Organizations that operate in environments characterized by high uncertainty must be prepared to make adjustments (decisions) continuously. They need on-line, real-time vertically-integrated information systems, and they need lateral relations.

Lateral relations, says Galbraith, "selectively employ lateral decision processes which cut

across lines of authority. The strategy moves the level of decision making down to where the information exists rather than bringing it up to the points of decision." In a decision environment heavily reliant on lateral relations, the manager is in effect a manager of shared information processing, responsible "not to make the best decision but to see that the best decision gets made." Decentralization is truly effective only in the presence of strong lateral relations, or sharing; otherwise, hierarchical decision processes become overloaded, and the organization has to fall back on the costly alternatives of slack resources and self-contained tasks. Galbraith's second pair should be the route of choice.

An organization, Galbraith says in summary, "must adopt at least one of the four strategies when faced with greater uncertainty. If it does not consciously choose one of the four, then the first, reduced performance standards, will happen automatically. The task information requirements and the capacity of the organization to process information are always matched. If the organization does not consciously match them, reduced performance through budget overruns or schedule overruns will occur in order to bring about equality."

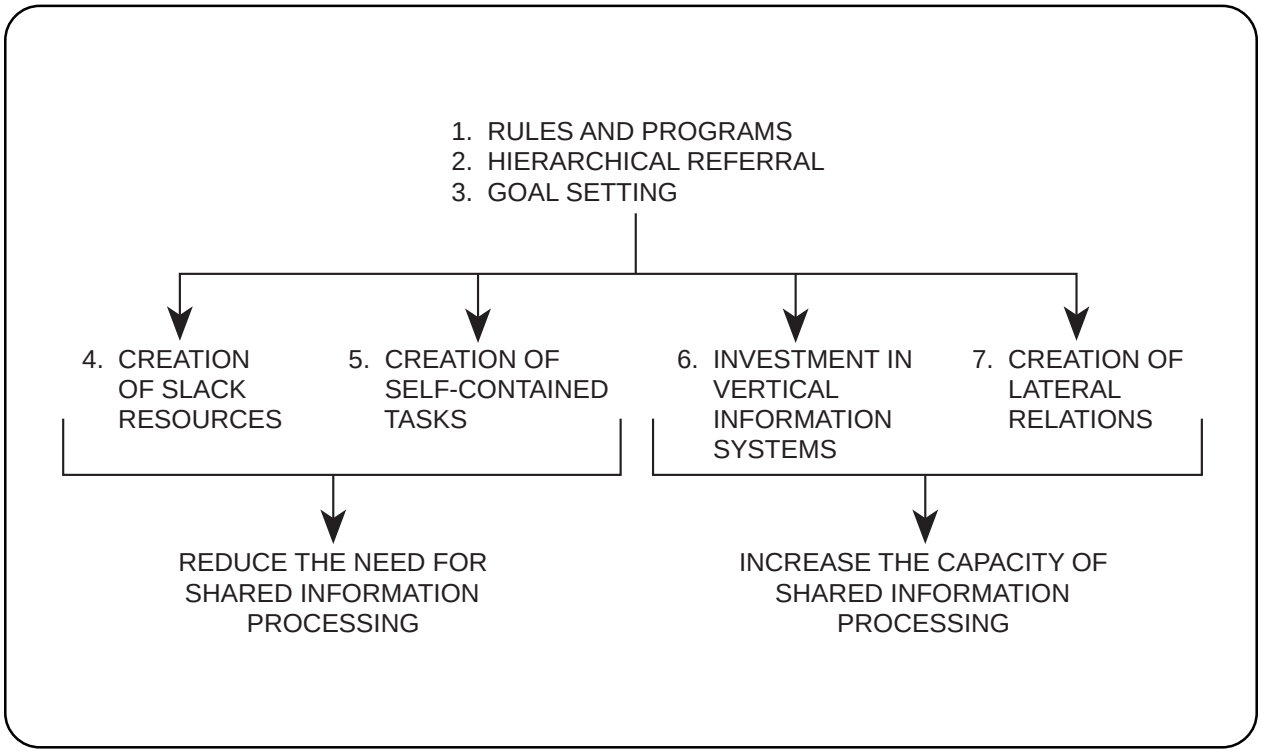

Figure 1.6.2.1.4. *Organization design strategies offer alternatives for managing shared information processing. (adapted from Galbraith, 1973)*

1.6.2.1.5. CORPORATE DATABASE EXAMPLE

Many people working out of a corporate database exemplifies the difficulty in sharing.

Corporate databases allow us to share data. Sharing data was never easy without the computer; with the computer the problem becomes messier. The popularity of the personal computer makes the problem of shared data an individual as well as an organizational problem (Frank, 1984).

Defining Corporate Database

A corporate database is a collection of all data within an organization, driven to third normal form and available through controlled measures to anyone within the domain of that organizational structure. This definition presupposes the following conditions:

1. Data are integrated from a number of previously discrete files, databases, or other access and retrieval systems.

2. Data can be shared among multiple users according to certain rules and procedures, without compromising data integrity.

3. The corporate database is a single repository for the totality of data for that domain of responsibility. (For example, in a noncomputer-based system, the corporate database could comprise all of the filing cabinets and their contents in a given organization.)

Certain features distinguish a *corporate* database from any other kind of database. To define a corporate database, one first must determine the organization level (domain of responsibility) the corporate database will comprise. If a company is the corporate database, then a department of the company can be nothing more than a custodian of one partition or portion of that database, at most. In short, a corporate database is mutually exclusive of other databases that might exist within an organization.

Our definition of a corporate database includes the necessity of controlling or minimizing redundancy. The aim is to reduce inconsistency in both data entry and data updating. The goal is the ability to share data that are accurate and consistent. Therefore, the system must include a means of intelligently sharing data and information. As C. J. Date (1981) defines it: "By shared, we mean that individual pieces of data in the database may be shared by several different users, in the sense that each of those users may have access to the same piece of data (and may use it for different purposes). Such sharing is really a consequence of the fact that the database is integrated."

Integration of databases implies the database is, according to Date's definition, "...a unification of several otherwise distinct data files, with any redundancy among those files partially or wholly eliminated." In practice, this would mean that any piece of data exists in one place and one place only (assuming a corporate database structure), and if anyone accesses data from the corporate database, it must be returned to the corporate database. This way, it is impossible for two versions of the same piece of data to co-exist in either the same or in different databases. This also implies the database is normalized.

Sharing of the Corporate Database

As indicated in our definition, the corporate database includes procedures and rules by

which individuals can share the data contained in it. However, within some environments, one must deal with the aspect of classified data, which seems to be directly at odds with the notion of shared data. Classifying data restricts sharing; thus, the problem is developing tools that permit us to relate these data to those who need it, without compromising classification, data integrity, and sharing of non-classified data. The needed corporate database should be able to intelligently share information, including classified data. This would entail developing levels of control for sharing. In theory, if you have a document that contains a classified figure, that number would never appear in that document until you accessed the document from the corporate database. The document would then have to access the classified data from the database to include the figure. This accommodates the requisite level of sharing and prevents the classified figure from having to appear in several locations or files simultaneously.

Within a decentralized organization structure, the temptation exists to create auxiliary repositories of data and information. This owes to considerations involving both corporate culture and human nature: it's often easier to work out of a "localized" file than to have to access a centralized repository which we've defined as a corporate database. Replication of data in locations other than the corporate database works at cross purposes with the rationale for having a corporate database in the first place. In general, nowhere but in the corporate database should there exist aggregations of data from or of data *derived* from the corporate database. This is achievement of the third normal form. Those needing to share that data have one, true, primary source for it: the corporate database. The farther one moves data away from its primary repository, the greater the chances that data integrity will be compromised.

Distributed database literature cites methods for managing the technical aspects of sharing data. Rothnie et al. (1980) and Kohler (1981) agree the two-phase locking (2PL) method of concurrency control is the best way to serialize data requests and updates. Though the technical problems (software, hardware, and networking) are well-defined and solutions exist, the broader, more-general problem of sharing needs to be addressed (Kohler, personal communication).

In many organizations, data are not stored centrally, nor are they stored in one medium. For example, a database might be every file cabinet, telephone directory, mainframe computer terminal, personal-computer floppy disk, and notebook. But this isn't a *corporate* database. A corporate database wouldn't permit duplication (redundancy) among the various storage and retrieval media such as the file cabinet and the floppy disk, both of which might contain different versions of the same piece of data. If, for example, data taken from a mainframe computer file and copied onto a PC floppy disk are altered on the floppy and not on the host file, then a sharing problem results. Investigation is required to control this intelligently to make sure there is no duplication of data within a particular domain of responsibility. This would require development of instruments to identify all of the data, where they are located, what data are dependent upon other data, and how to guarantee that when someone borrows a piece of data they don't compromise its integrity or that of that of the corporate database.

Special Concerns in Establishing Corporate Databases

Hierarchy of decision mechanisms is an important consideration (Galbraith, 1973). If qualitative data are put into the system, one wants decision mechanisms close to the data, because qualitative data (unlike quantitative

data) can lose integrity as they move away from the source.

In terms of lateral communication (horizontal): Different personalities place emphasis on maintenance of different kinds of data. Changeovers common in some organizations can affect how data are maintained and handled. New people might stress different levels of concern, interest, and importance, depending upon who's managing. What results is a corporate database problem in terms of keeping the corporate database clean. For instance, if one manager wants data files A, B, C, D, E thoroughly maintained and updated, another may come on board and insist that D, F, H, I, and J are the most important. Then, the data in A, B, C, and E may fall into disrepair, and if we assume a computer-based system, it might not always be possible to determine when data have become outdated. (In a filing cabinet system, physical appearance of the paper may give a clue.) Thus, the corporate database is growing as new and changing demands are put upon it, but only the most recent data files are being maintained. One needs to be able to clean up the data in those files, or risk a problem with data integrity down the line.

The reverse problem can also occur as different personalities in management dictate shifting values of data in a corporate database. A new manager may place a high value on data files that had been maintained by a person long since departed. If these data haven't been kept current, problems can arise.

If we gather and maintain data about data, then we also need to determine which data, what are their value, location, etc. This sort of activity requires a data administrator. The function of this person would be to determine data about data. With accurate data about data, the organization can then manage and maintain the corporate database, reduce or eliminate redundancy, and know who's been using which pieces of data.

In effect, we need more *data about data*:

1. When it was put in.
2. Who put it in.
3. Why was it entered.
4. When was it updated and how often.
5. Level of confidence in the data.

We need to clearly define the functions of the data administrator, and to identify specific data about data requisite for meeting the terms of the definition of a corporate database. The goal is to move from the real-life situation toward the ideal, where we have a shared corporate database. Doing this requires:

1. Data about data.
2. Defining the function of the data administrator.
3. Moving data toward a single location and with little or no redundancy (third normal form).

Not only do we need to determine data about data, but we need data about databases, and especially those which may be geographically dispersed. Among the considerations here would be:

1. Defining partitions.
2. What records are kept in which partitions.
3. What kinds of records are kept where.
4. How old.
5. Who updates the records.

1.6.2.1.6. HIERARCHICAL PLANNING EXAMPLE

When different levels in an organization develop plans, they must share data and information or work at odds with each other during the planning process and afterwards when they implement their plans.

One way we can share information among a number of people at several levels of an organization's hierarchy is through hierarchical planning. Keeping plans at organizations lower in a hierarchy consistent with top management organizational goals doesn't happen automatically. This consistency requires a set of reporting procedures designed to motivate plans whose bottom-up formulation aligns with the top-down directives. Hierarchical planning helps in this process. I'll discuss hierarchical planning for its value in sharing information.

Hierarchical planning is an instrument to measure and evaluate the usefulness and effectiveness of plans. Under such a standardized system, all plans might consist of (1) an executive summary, (2) a series of chapters, and (3) appendices. The objectives would be to gain credibility, increase consistency, reduce workload, and have a plan that can be used.

Defining Hierarchical Planning

Hierarchical planning is top-down directed and bottom-up formulated. Each organization lower in a hierarchy produces its own plan in accordance with directives issued by top management. The plan of the organizations lower in the hierarchy includes an executive summary written to meet top management format and guidelines and includes summary-level data in appendices formatted to suit top management. At the middle level in the hierarchy, the executive summaries are skimmed off the top of each plan of the organizations lower in the hierarchy and built as chapters into the plan for the middle level in the hierarchy. Also the summary-level data, appropriate for use of the organizations in the middle of the hierarchy, become the detail data for the plan of the organization in the middle of the hierarchy.

The contribution to the plan of the organization in the middle of the hierarchy is then the preparation of their executive summary to meet top management format and guidelines and to represent all the chapters of their plan and the summarization of the detail data to meet top management's format. The information in the executive summary of the organization lower in the hierarchy is shared between that executive summary and the chapters of the organization in the middle of the hierarchy. The same is true with the shared data of the appendices.

At the regional, lead, or divisional level (other mid-level organizations in the hierarchy), the process is repeated. The executive summaries of the organizations in the middle of the hierarchy become chapters, data are summarized for appendices, and the higher-level organization writes an executive summary representing their chapters. In the same fashion this process is continued at all levels of the hierarchy including the top level. The result is that information is shared at all the levels, they all are consistent, and productivity is increased.

Aspects of shared information affect the success of hierarchical planning. For good effective hierarchical planning, top management must clearly communicate to all other levels in the hierarchy the goals and objectives to be accomplished by the plans. In turn, these mid-level organizations must properly interpret these goals and objectives and integrate them

into their plans. Their executive summaries should represent the plans' contents if the summary documents represent plans of all the lower levels in the hierarchy.

Sharing in Hierarchical Planning

Promoting consistency at and through the hierarchical levels can also help prevent hoarding. There's less demand for additional information from the top down when the upper level gets the information it wants and needs. Information may be power, but data aren't. Data should be open, and this is a necessity if we're to develop information from those data (and the personal biases involved). Data-hoarding impinges on human considerations that view data-hoarding as a means of cutting off the flow of information.

Chakraborty and David (1981) cite lack of discipline and motivation for effective planning. The continuous review and accountability brought on by the plan invoke fear and resentment within those preparing the plans. Plans threaten the independence of the manager by exposing forecasting errors to others within the organization. Qualitative data won't usually make it up the chain of command intact; formatted qualitative data have a better chance; quantitative data is closer to a sure thing (Galbraith, 1973).

All definitions of management include planning, but we must distinguish between the introspective, coordinative process of planning and the resulting product. We want to produce useful products, or tools, to be used as guides for when we perform the control function of management. However, these formulation tools usually sit on the shelf and gather dust. The problem is that the process and products don't fit the manager and what he or she manages.

How Are Government Organizations Affected?

A tremendous number of plans are generated within government organizations: contractors have plans, the field offices have plans, the area offices have plans, various units at headquarters have plans. In some cases where the activities of multiple government agencies overlap, each of the agencies may have its own set of plans, and, in fact, government subgroups may have their individual, independent, inconsistent plans. The problem is those plans aren't very well coordinated, and in some instances, may actually embrace conflicting goals and objectives. In these situations sharing is needed, and parochialism must be held to a minimum. Here, the tools managers should be using don't work together to serve the business of planning and execution.

There can also be difficulties at the top administrative levels within a government organization in terms of understanding plans formulated by entities across the organization's broad areas of responsibility. In part, these difficulties can stem from some rather basic and often simple differences in physical and editorial formats, bases of assumption, constraints, and goals and objectives. This makes planning and coordination more difficult.

The industrial engineer's approach to management says to plan from the top-down and to implement from the bottom up. But this cannot always be the case in an organization. A perfect example is a waste clean-up organization, where planning occurs from the bottom-up, because the real "forcing function" in dealing with waste products (which result from production activities) is in the field, not at the headquarters level.

In planning top-down, however, there is a headquarters Master Plan, and the lower echelons can then fit their goals and objectives into those of the Master Plan, and in theory, at least, if all of the individual goals and objectives at the lower levels are met, then the goals and objectives of the Master Plan will be met. But in some government organizations this

scenario is muddied by the fact that there is wide-scale decentralization, numerous self-contained tasks, geographical dispersal, large number of hierarchical levels, and many different kinds of plans (program, strategic, etc.).

Special Concerns in Establishing Hierarchical Planning

We need to test strategic plans, program plans, and other plans in the same manner that emergency plans are tested. Emergency plans are tested to see how well a group of related plans work together to achieve a common objective, and where differing jurisdictions are involved. This tests the quality of sharing and leads to development of common plan attributes: format, assumptions, and goals and objectives. In short, the goal is tools consistent with all stakeholder's plans, incorporating data integrity and lending themselves to sharing.

1.6.2.1.7. A Simple Sharing Data Situation without Computers

Even in traditional office settings without computers we've never learned to share data, information, decision mechanisms, and information processors.

In his landmark book discussing the Theory X and Theory Y of management, Douglas McGregor implies that we need to share in our high-technology society. McGregor says, "No individual in society is completely independent. Interdependence is a central characteristic of the modern, complex society. In every aspect of life we depend upon each other in achieving our goals. We don't grow our own food, make our own clothes, provide our own transportation or shelter, educate ourselves. We've learned that as a society we can have more of everything we want by specializing individually. However, the price of specialization is dependence on others." (Douglas McGregor, *The Human Side of Enterprise*, McGraw-Hill 1985.)

Webster defines sharing as "to have or use in common with others." Sociologists who study sharing are interested in the common aspect of what we share. With the coming of the information age, problems in effectively sharing data, information, decision mechanisms, and information processors have become more difficult. The key to more effectively sharing is to understand sharing and understand how we share manually without computers or automation. Just as we learn to dance by first learning the steps and then applying the music with ever-increasing tempo, I'll examine manual methods of sharing to derive the basic steps and then develop the considerations for sharing more effectively when using computers. Automation merely increases the speed, volume, and audience of the sharing environment. In short, for sharing we must understand how we walk before we can run.

We've always shared corporate data. We simply haven't thought of it as such. Consider the company file cabinets, a database of corporate data. All of us need to access these files at some time—either to put things in, take things out, or just look around (read, write, review, and update). I'll illustrate the concept by describing an example of writing a report (creating information) that requires some data contained in the filing cabinets. I retrieve the necessary data from the files and decide not to make copies of the data or indicate that I've taken the data. I use the data retrieved as the foundation for my report by cutting and pasting the data for my report. After completing the report, I replace the old report in the file with my new one, thus returning some of the uncut data to the files, losing the rest, and including some of the information generated in writing my report. Sound familiar?

Now, let's look at what I did to write that report. First, I borrowed data from the corporate files without indicating I did so. Another person needing something from the filing cabinets while I have the data will either recognize that those data are missing, or won't know. In the former case, the missing material must be identified, located, and retrieved. In the latter, new information may come from incomplete data.

Second, I've taken corporate data, edited some, lost some, and exchanged some. Another person using these data to make information to support decision-making won't know the data are tainted. There's no indication of my assumptions in the bias, if my changes have

precedence over the original, or when, or what was done to the data. The person doesn't even know if the data he or she first retrieved are the original data. For that matter, I don't know if the data I used are the original data either.

Third, I've not considered the value of the data in terms of risks and consequences—both good and bad. I haven't considered who should be allowed to access the data. (The illustration in Figure 1.6.2.1.7. shows an example of computer crime—a form of sharing we don't want.) When I returned the new report to the file, I may have updated the data making them appear up-to-date. Have I really improved the data? Are the data more accurate? Are the data more current? Could my changes result in a decision with potentially severe consequences?

I'll bet my example of borrowing from the file cabinet is familiar to you, but I'll continue to thicken the sharing plot. Let's look at sharing the information I just created in my report. I've finished my draft of the report, my information document, but I want several people to review what I've written. I make several copies of my report and distribute the copies. I've just shared information.

Consider several factors in the sharing of this information. For example, the time frame (shelf life) of the data help determine the applicability of the data. I need to know the location of all copies of my report if I want them returned. The value of the reviewer's comments, the nature of his or her data source, and his or her own hidden agenda are all critical in my understanding of what I'm expecting from the reviewer. The priority and sequence of dissemination and collection, and the level of each review (i.e., check for typos, substance, philosophy) help determine the bias of the reviews (sharing) as the information sharing progresses. Many questions must be answered and understood prior to making decisions about the effectiveness of the review (sharing) process.

In my story, I've discussed sharing data and gleaning information. Now I'll continue the story to include sharing decision mechanisms. Each recipient returns his or her marked-up copy of the report to the secretary for the final draft. After sharing information, changes are received from several sources. How do I incorporate each of these changes into a single document. Whose changes take precedence? Who decides? What are the effects of first-made versus last-made changes, uninformed changes due to different understandings, and inaccurate changes? What is the time frame during which the information is valid? Have all the reviewed copies been turned in, and if not, where are they? Which of the reviewer's inputs is most valuable? Should any of the reviewers see each other's comments during the review process? The secretary is besieged by reviewers, each of whom knows best. He or she must produce consensus on the new report.

What process does the secretary use to resolve differences in reviews? How does he or she use the process? What constitutes the final draft? All these questions relate to sharing the decision mechanism. As the secretary and the reviewers interact, they're acting as the decision mechanism for the final decisions.

There's one more thing to share in my story. Remember the report I drafted several paragraphs ago? I used the secretary's word processor to produce the report. Consider the word processor, as a simple data processor. The owner of that word processor had it configured with certain margins, leading, etc. I used the word processor for my report and altered the configuration to my liking.

Again, we can ask the same questions. Whose alterations are acceptable? Is the word processor still in use, or am I finished? Will the word processor be in use again shortly? Who's the

user? Of what value is the use? How much time was spent in determining what was reconfigured, resetting the configuration, and then complaining about it?

Something seemingly as simple to share as a word processor can alter the data produced. Altering data may change the information generated. Changing information may alter the decision. Changing the decision may change the action taken on what is managed. A different action may alter the measured data. And the cycle through the Management System Model begins again. With each iteration through the cycle, I've altered the balance among the what is managed, who manages, and what is used to manage components of the Management System Model.

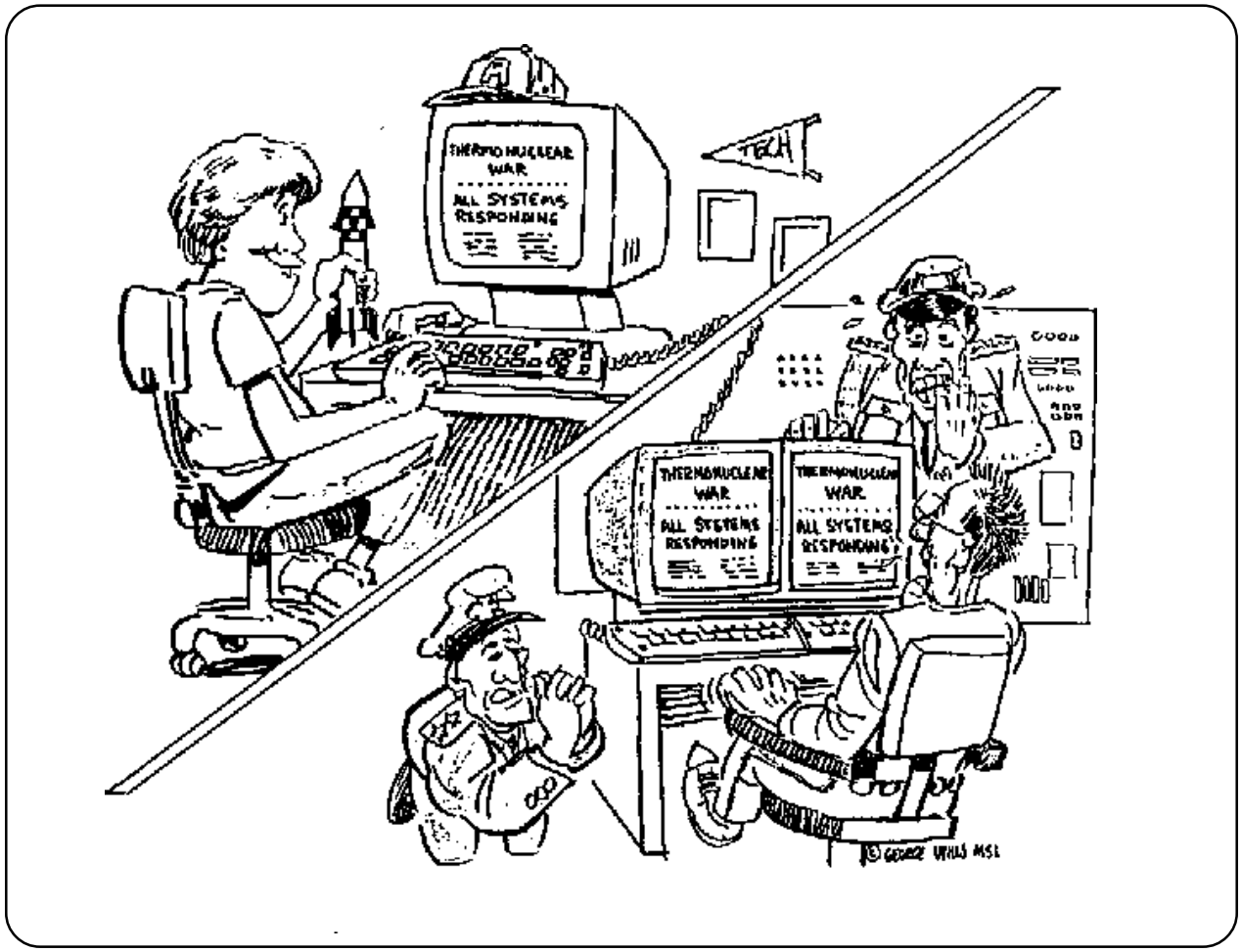

Figure 1.6.2.1.7. *"I think I'll share some of this government official's corporate data."*

1.6.2.1.8. Questions about Sharing Apply to Shared Information Processing

We've never produced a successful corporate database and information sharing network because we've never answered fundamental questions about the experience of sharing.

Can you show me a successful corporate data base and information sharing network? I've heard a lot of people talk about how good it's going to be when she or he has corporate data. But, I've never seen a real operating shared information processing experience that the sharers felt good about.

We've come a long way with information systems and personal computers. But now, in addition to working independently, we want for many of us to work with the same information and data. We want to share. We don't know how to share. We can't share computer-based data and information for the same reasons we can't share data and information in file cabinets, rolodexes, notebooks, and other mechanisms serving the same functions as computers. We don't understand what it means to share or what a sharing experience involves.

Technology is forcing managers to share information more than ever before. Competition is forcing a manager to encourage innovation, delegate authority, and change his or her standard operating procedure. The key to providing managers with the best information is to understand how managers share data, information, decision mechanisms, and information processors. I call this collection of activities shared information processing.

You need to use your management tools better by participating in more shared information processing. To use your management tools well, you must first learn how to share. Even before recent changes in technology, such as networks, copy machines, and large databases, you knew you weren't sharing. Technology has made the problem worse, because now you believe technology helps you share. You believe new technology is improving your performance and productivity. Unfortunately, technology isn't helping you share better, but instead is helping you fail faster and on a more global scale.

My position is quite simple. Until we understand how we share cookies, library books, office files, data, and information, we won't be able to improve our use of management tools. Our attempts at sharing are hurting, not helping, our productivity.

Shared information processing is a difficult concept to understand and use. I suggest we separate the concept into 1) information processing and 2) sharing.

The Management System Model (MSM) highlights the concept of information processing by modelling the conversion of data to information through management tools and the conversion of information to action through decision making. The MSM brings us an understanding of the domain of responsibility of the decision maker. The MSM also brings us the human characteristics of the decision maker within the domain of responsibility.

I'll now use the MSM to highlight the concept of sharing. I'll link the information processing model and the sharing model when we consider what we're sharing. That is, when what

we're sharing is data, information, decision mechanisms, or information processors, then we've linked the general sharing model with the information processing model.

We never learned how to share data and information in file cabinets. We never realized the dilemma of sharing versus hoarding, or protecting, information. We never figured out the issues of priorities and ownership of information.

Until we understand the dynamics of sharing, we aren't going to realize any additional benefit from our sophisticated information systems. What we need is a focusing mechanism: a model of shared information processing, simple and general enough to apply easily and broadly to sharing, yet detailed and specific enough to help identify key shared information processing variables and their relationships. Such a model will allow us to study shared information processing.

The first step to understanding sharing is to know what questions to ask. The second step is to answer them. My model begins to answer the questions. The answers and the model are in Module 1.6.4.8. Here are the questions.

First, what constitutes a sharing experience? How do we delimit the experience? How do we get a sharing experience? How do we know we got the experience? This view is a macro-view or static view of sharing.

Second, what is the result of sharing? Are there different kinds of results? Are there different kinds of sharing? These questions relate to what I call the product of sharing.

Third, what elements make up a sharing experience? Which are necessary, sufficient, or nice? The elements are the things I look for from a microscopic view to identify or build a sharing experience.

Fourth, what tools or techniques help sharing? How do we apply the tools to the elements? Once we have the elements for sharing, we use tools to operate on those elements to generate sharing.

Fifth, what's the process or procedure to relate the elements and tools so we consistently get the desired product? What are the steps or phases in the process? What is the sequence and timing of those steps? The process tells us how to use the tools on or for the elements to get the sharing experience we want.

If you like analogies, compare my five sets of questions to the idea of baking a cake. Baking the cake is the experience. The kind, size, and so on of the cake is the product. The ingredients are the elements. The cooking utensils and equipment are the tools. And the recipe is the process. If you don't know these things, you'll bake the cake randomly, won't have any idea what cake will result, are apt to hurt yourself or destroy the cake, and can't develop skill or improve your cake baking.

1.6.2.1.9. A Model for Sharing

We can understand sharing better by relating the products, elements, tools, and process of the sharing experience.

To diagnose, design, or conduct a sharing experience, we have to *define the product*, *know the elements*, *be able to use the right tool at the right time*, and *have developed a process*. So we must characterize the experience generally, and specifically in terms of product, elements, tools, and process. This means we have to understand, operationalize, measure, and relate variables of the sharing experience and its product, elements, tools, and process. My model will describe and begin to define these things.

What Are the Products of Sharing?
The result of sharing is a transfer or exchange of something or change in something you already have. We can determine the result as an output or outcome of the experience. The result can be good, bad, or neutral. The product of sharing will be affected by what is shared, how it's shared, who shares and why they share, and when and where the sharing takes place.

What Are the Elements of Sharing?
The elements of sharing will tell us the what, how, who, why, when, and where of the sharing experience. In Figure 1.6.2.1.9.1., I present the elements of the sharing experience. By design, Figure 1.6.2.1.9.1. is a simple view of the sharing experience. The sharing experience is quite complicated, and a comprehensive figure would be too complicated to draw.

The stakeholders in Figure 1.6.2.1.9.1. are *who* shares. There must be at least two stakeholders for sharing to occur. Usually, more than two stakeholders participate in a sharing experience; but as the number of stakeholders increases, the number of possible relationships between stakeholders increases as a function of two to the power of the number of stakeholders.

Every stakeholder has a need to share. This need is a combination of the value, motivation, and intent influencing *why* stakeholders share. I assume the major reason stakeholders share is to maximize their overall gain/loss ratio.

The sharing experience is initiated and perpetuated by motivators. Motivators may be either internal or external to the boundaries of the sharing experience. Motivators serve as forcing functions and/or boundary conditions. Motivators affect the motivation of stakeholders and influence the boundaries of the sharing experience. A motivator could be a simple sharing opportunity for two or more stakeholders. However, motivators could also be mandated by someone outside the sharing environment.

An example of an external motivator is the Freedom of Information Act, which could lead two stakeholders to share information. (For interesting discussions of how external mandates affect sharing, see R.N. Clark, "Collusion and the Incentives for Information Sharing," *The Bell Journal of Economics*, V14, 1983, pp. 383-394 or Ester Gal-Or, "Information Sharing in Oligopoly," *Econometrics*, V53, N2, 1985.) Motivators for sharing could come from within the sharing environment. Gatewood describes information sharing among Southeast Alaskan salmon seiners as "a wise strategic maneuver" (J.R. Gatewood, "Cooperation, Competition, and Synergy: Information-Sharing Groups among Southeast Alaskan Salmon Seiners," *American Ethnolo-*

gist, V11, N2, 1984: p. 362). Economic prosperity and increasing prestige motivate their sharing.

Linkage mechanisms connect stakeholders. The linkage mechanism represents the sharing process and shows how things are shared. Linkage mechanisms bring together tools we use to help us share. Examples of tools for shared information processing include notebooks, file cabinets, computers, phones, and many more. An entity is *what* is shared. For example, in shared information processing, stakeholders can share decision mechanisms, information, data, or computers used to process data into information. These entities of sharing correlate to the activities of shared information processing: data, information, decision mechanisms, and information processors. Of course, stakeholders can share other things indirectly related to shared information processing, like office space, a secretary, or a budget.

The environment represents *where* and *when* the sharing experience takes place. The environment delimits the sharing experience.

What Are the Tools of Sharing?
The tools of sharing are used to help stakeholders share. Sharing tools include meetings, mail, telephone, telefax, copy machine, computer terminal, and many more. In sharing, stakeholders transfer or exchange ownership or change something they already own, all affecting the stakeholders of the sharing experience. The transfer or exchange can be 1) one-to-one, 2) one-to-many, 3) many-to-one, or 4) many-to-many. Sharing tools help accomplish one or more of these types of transfer or exchange. As intervenors, we can contribute to sharing by developing good tools and knowing which sharing experiences a given tool will work in. The tools help bring the elements of sharing together. They help with such things as when (schedule), who (personality type), where (facilities), and so on.

The Process of Sharing Links Stakeholders.
A stakeholder is more than just a human being; a stakeholder represents a domain of responsibility. A domain of responsibility contains, in addition to the human manager, the physical things the manager is responsible for and the tools used to manage.

I'll look at the simplest combination of stakeholders in a sharing environment. In Figure 1.6.2.1.9.2., I look at the sharing experience occurring between two stakeholders. So Figure 1.6.2.1.9.2. is a close look at a portion of Figure 1.6.4.8.1. and highlights the linkage mechanism, or sharing process.

The *need* in Figure 1.6.2.1.9.2. includes the reasons for or the purpose behind a sharing experience. The need of a stakeholder includes the value to the stakeholder, the intent of the stakeholder, and the motivation of the stakeholder. Examples of value, intent, and motivation are gain/loss, parallel versus serial, and altruistic versus selfish, respectively.

The *entities* in Figure 1.6.2.1.9.2. are what the stakeholders share from within their own domains of responsibility. The entities influence the motivations of either stakeholder to share, because shared entities are used to assess the gain/loss ratio.

For the salmon seining example, skippers of salmon seine fishing vessels made various calculations before they decided to share information. The entities being shared aided in these calculations. The skippers had to make decisions about where to fish. This decision affected what information was shared. Gatewood suggests skippers decided to share information so they could "make wise decisions as to where to fish while reducing travel time and related costs" (p. 357). The decision about where to fish was common to all skip-

pers. But, those skippers who shared information did so based on the calculation of how they could increase their catch by sharing information versus the losses they would experience if they didn't share information. The skippers actually shared many other things: common fishing grounds, the possibility or increasing or decreasing their prestige as skippers, and their ability or inability to attract the more skilled crew members.

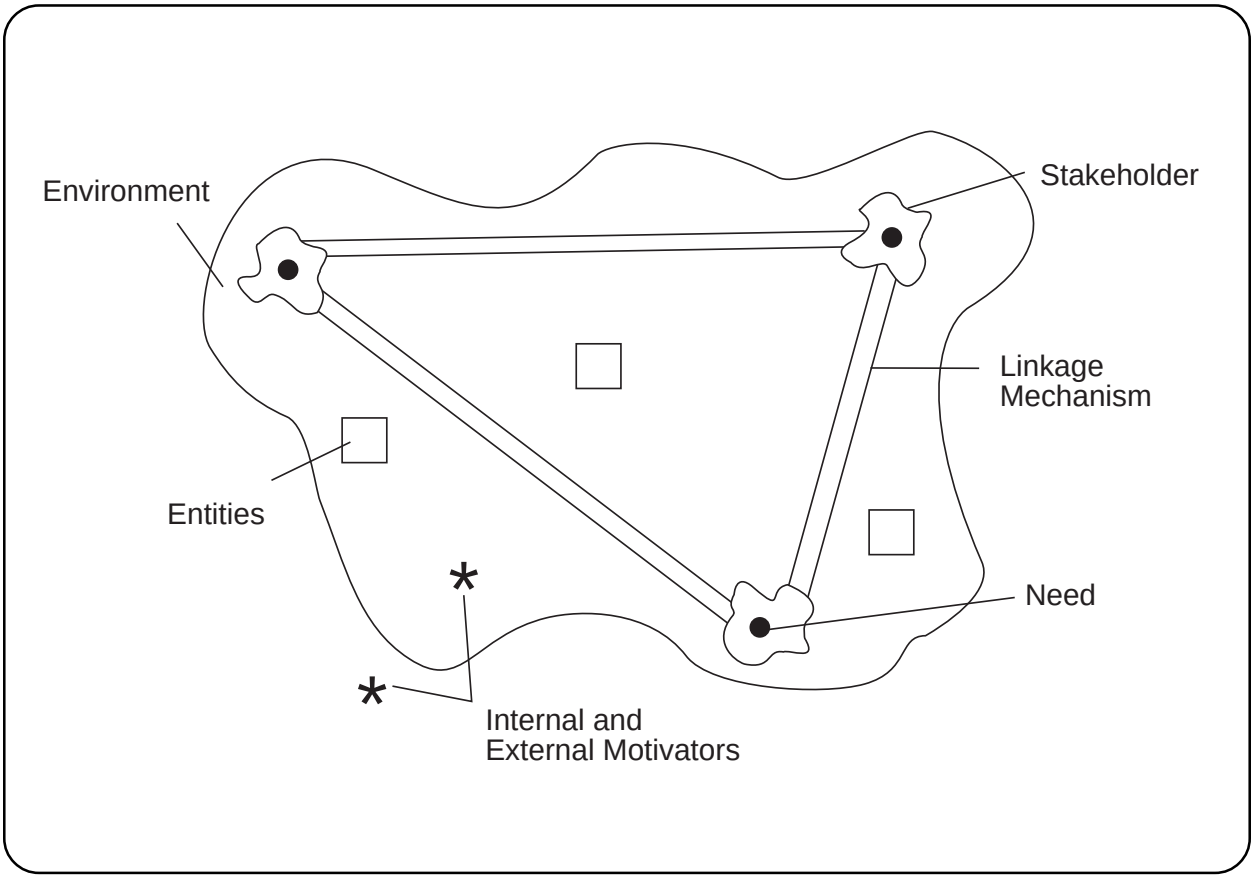

Figure 1.6.2.1.9.1. *The elements of the sharing experience show how sharing works.*

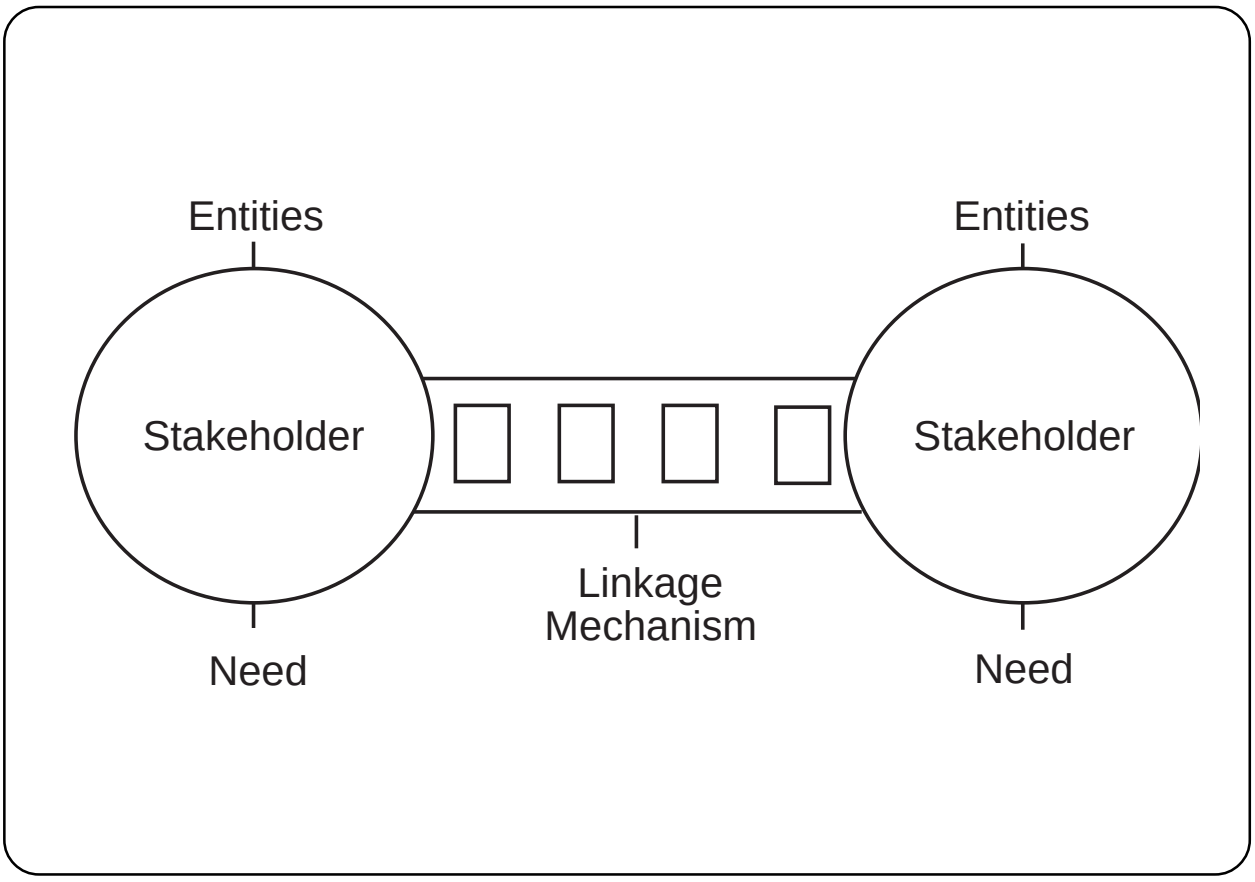

Figure 1.6.2.1.9.2. *The sharing process, including the linkage mechanism highlights the process element of the sharing experience.*

1.6.2.1.10. THE PHASES OF THE SHARING PROCESS.

The sharing process involves a cycle of four phases: recognition, formulation, execution, and evaluation.

The sharing process is the map for putting the elements and tools together to achieve the desired results in a sharing experience. The sharing process, like any process, should be considered in terms of activities, time, resources, and performance. I believe sharing occurs in four phases, represented by the linkage mechanism in Figure 1.6.4.8.2. Figure 1.6.4.8.2. shows the sharing process as a linkage mechanism between stakeholders. The sharing process is like any process in management. The process is cyclic in that we learn by the sharing experience, and learning affects that experience or other experiences in the future. The phases of the sharing process include recognition, formulation, execution, and evaluation.

Stakeholders must *first recognize* the opportunity to share. Part of the recognition occurs when the stakeholder examines the gain/loss ratio. Will I benefit or lose if I share? The recognition phase shouldn't be considered one-sided, since there will be recognition by both stakeholders. In the seine fishing example described by Gatewood (See Module 1.6.4.8.), both skippers had to recognize the opportunity for sharing and the attendant benefits to each for sharing to occur.

Once the opportunities associated with sharing have been recognized, the stakeholders will enter the *second* phase and will *formulate* a plan. Using the seine fishing example, the plan involved where to fish based on the information shared between the two skippers.

Third, the stakeholders will *execute* their respective plans. I believe this phase is the most mechanistic because it's most heavily influenced by the tools stakeholders use to share.

Fourth, the stakeholders will *evaluate* the sharing experience based on its result. The stakeholders will evaluate the outcome of the sharing process for continuing and updating the process to meet their needs. The evaluation phase will result in a recognition of future sharing opportunities; and the cycle starts again.

Consider the similarity between the steps in the Plan-Do-Study-Act Cycle and the phases of the sharing process. Plan relates to formulate. Do relates to execute. Study relates to evaluate. And act relates to recognize. Since Plan-Do-Study-Act comes from the scientific method, I'd expect correlation to sharing.

A sharing experience is an activity and can be managed like an activity. That is, project management concepts are transferable to the sharing experience and applicable to the recognition, formulation, execution, and evaluation phases of the sharing process. We use the sharing tools during the sub-activities of sharing experience.

What Can We Do to Improve Sharing Performance?

I believe our ability to share information is similar to our capacity to process information. The way shared information processing affects our organization's performance and productivity is influenced by our ability to share. Obviously, having the best information (through appropriate sharing) affects our

organization's product or service and affects our productivity in producing our product or service from our resources.

But let's focus on how well we share. How do we figure out what is the right thing to share and figure out how to share that thing right? What can we do to improve our ability to share; that is, improve our sharing performance? Galbraith (Jay Galbraith, *Designing Complex Organizations,* Reading, Massachusetts, Addison Wesley, 1973) gives us strategies for processing information.

I believe we can adapt and transfer his strategies for sharing data, information, decision mechanisms, and information processing. Transferring Galbraith's ideas, I believe we can 1) reduce the need for sharing or 2) increase the capacity for sharing. We can reduce the need for sharing by 1) creating slack resources or 2) creating self-contained tasks.

If we over-commit resources to a mutual problem, we don't need to share as much information or to share it so well. If we separate information and decisions using that information, we don't need to share between the stakeholders who are making the decisions in their self-contained units.

We can increase the capacity for sharing by 1) improving information systems, especially vertical information systems, or 2) creating lateral relations. As we develop future information systems, we must consider building more integrated data and information stores. Informal non-threatening data and information exchanges enhance our capacity for sharing. We need to establish these relations by developing mechanisms to help the relations work better.

Finally we have to consider the opposite of sharing: hoarding. Protecting data and information can often be a good form of hoarding. We have to distinguish between when to share and when to protect or we'll hurt our organization's performance.

Most managers don't know how to share. Most managers expect new technology and sophisticated information systems to help them share information better. Until we understand the dynamics of sharing and the importance of the elements of sharing, we won't share well—which may be worse than not sharing at all. I believe my model of sharing helps us understand what sharing is and how we can integrate the concept of sharing with that of information processing. We have a handle on describing sharing. Now we can observe sharing and, by trial and error, find tools and techniques to help or hinder sharing in a given sharing experience. Ultimately, I want to find out why tools and techniques work so we can characterize a sharing experience and prescribe what tools will work in that experience and predict the results.

1.6.2.1.11. INTERACTION AMONG PEOPLE—EDOUARD MANET

1.6. Group Decision Making

1.6.2. Group Decisions (More than Two)

1.6.2.1. Information Sharing

1.6.2.1.12. Nominal Group Technique

1.6.2.1.12.1. THE VALUE OF THE NOMINAL GROUP TECHNIQUE

NGT is wonderful for idea generation and efficient meetings, but not quite so good for effective meetings and consensus.

Nominal Group Technique (NGT) is a common, valuable, often misused tool for group decision making. You misuse the NGT when you expect NGT to bring a group to consensus. Consensus requires identifying, acknowledging, scoping, confronting, and resolving conflict; and NGT alone will accomplish none of these activities. However, NGT is wonderful for free and abundant idea generation and for efficiently (not effectively) bringing a group to a relatively-well-documented decision. An efficient meeting runs smoothly and generates results. An effective meeting is on the right topic, involves the right people, occurs at the right time, and generates the *right* results.

In a world of wasted or even counterproductive group interaction in meetings, any semblance of process, progress, or result can help people feel productive, which is good. However, in this environment being lulled into a temporary feeling of agreement and commitment followed by no follow through on decisions made will make people even more frustrated than before, which is bad. Therefore, if you use NGT for what it is best suited for and are careful that people have realistic expectations, NGT can be wonderful. Furthermore, the individual steps of NGT are wonderful examples of steps you can custom tailor into a group decision making process to achieve specific results you want.

The steps of NGT sometimes are most useful when you use only one or two of the steps in a facilitation process to move a stagnated group forward. I add a few steps to the standard five-step NGT process so I can help some of NGT's weaknesses. For NGT, helping weaknesses doesn't resolve weaknesses. Your best bet is to recognize the strengths and weaknesses of NGT and use NGT in whole or in part to take advantage of the strengths.

Where does NGT fit into facilitation? In the 7-P model for meetings in Module 1.6.2.2.13.1., the sixth P is for process. NGT is a set of steps that suggests a process for facilitation. NGT is a process tool for facilitation. You can use one or more of the NGT steps as you identify the process you want to use for facilitating the group. Also, the 7-P model requires before you begin the process (such as NGT) that you have clearly defined the issue to be worked on (the third P is for problem) and the people who will participate (the second P is for people). Example issues might be 1) What are the action items we need to accomplish to increase our sales by 20% this year?, 2) What skills do management systems engineers need to be successful?, and 3) How can we find better programmers in a highly competitive market for good talent? (Consider the 7-P model. The fifth P is for participation. When using the NGT, participation is free and open information sharing and controlled, facilitated participative decision making.)

Each participant needs to know his or her role in the meeting and what contribution is expected of him or her. When a willing and able participant doesn't have a role, he or she will contribute something, and that something is usually disruptive. You also need to make sure all the perspectives of the issue under consideration are fairly represented among the participants. Unrepresented stakeholders and other critics will discredit the results of decisions made by a group, thus discrediting the composition of the group. When assembling the

group, consider all stakeholders. Any stakeholders not represented are not going to be committed to the result. The NGT is designed to get relatively equal and unbiased ideas from each participant in the group and to rank order the ideas.

The words nominal group mean a group in name only. To make an effective intervention in the workings of an organization supported by the group, you need to convert the nominal group into a real group. A real group is a group of people who share common interests and are able to communicate well so they can develop consensus around neeeded results that they are committed to following through with.

The potential problem with a real group is group think. Group think is when a group is so close and collaborative that a bad idea in the group isn't challenged enough and the group risks going to Abilene (Jerry Harvey, "The Abilene Paradox: The Management of Agreement," *Organizational Dynamics*, Summer 1988, pp. 17-34. [Kurstedt, Module 1.6.2.2.11.]) and other dysfunctional behavior.

I find that 16 participants is the best number of people to be facilitated in group decision making. My nuclear engineering background suggests a magic number related to 16. (Four squared is 16, and two squared is four.) My facilitation experience suggests that more than 16 is difficult and less than 16 isn't good representation—unless, of course, the number of participants less than 16 is everyone with a stake in the result. I have facilitated groups with as many as 40 people and as few as three. The problems with large groups are not moving the process at a fast enough rate to keep everyone's interest and having trouble making sure everyone has ample opportunity to express their views. The problems with small groups are inadequate representation, and lack of mutual stimulation of creative idea generation.

Successful NGT (or any participative decision making tool) requires a convener (usually a manager) who believes in participation and the value of group action. If potential group members believe any participative activity is an empty activity, he or she will find a way out of the meeting and send someone in his or her place who may not have the ability, understanding, or authority to represent his or her constituency. Then, you will have an empty activity. A good convenor provides a need, impetus, and resources to bring the group together and supports the group action before, during, and after the meeting.

I've never had a group with a bad result from the interaction of the participants. I've had participants who were outliers, with strange, angry, or misguided ideas. But the will of the group filters the ideas of outliers well. I recommend that the convenor agree to implement to group's ideas at the outset—or at least agree to implement some fraction of the ideas, like 70%, 80%, or 90%. That means that the convenor believes that 7, 8, or 9 of about ten high-priority ideas generated by the group are as good as or better than what the convenor might generate. See Module 1.6.2.1.13. for a good reason to believe that the group's result may be the one to use.

Since a well-constituted group has broader and more specific knowledge than any one person, the odds are in favor of the group's result. Since the group members or the constituencies of the group members will probably be the ones to implement the ideas or will have the ideas implemented on them, the group's result clearly is the one to follow. The convenor may have some inside information affecting an idea or two, but groups will accept that response, even after the fact. That is, if I do my best to generate a result and you tell me the majority of what I did is meaningful and will be implemented but due to inside information you can't share with me, you'll make minor changes, I'll buy in.

If the participants in a group believe most or all of their hard work will be implemented, they'll be motivated and bring an even greater sense of responsibility to their work. I am positive the group will generate an excellent, responsible action plan. I recommend the convenor follow the plan.

Successful NGT requires a facilitator who only works the process and doesn't get involved in the content of the discussion. The objectives of the facilitator are to move the process forward and to ensure that each participant believes he or she has had adequate opportunity to express his or her views. Our studies have shown that people feel more like consensus if they feel they've had adequate opportunity to express their views. No other variable seems to have much effect on their feeling of consensus—at least feeling consensus during the meeting and shortly thereafter.

Based on my experience, the big worry is that a short time after the NGT meeting there is little commitment to the NGT results and the meeting doesn't yield anything tangible but the meeting itself. Especially after a well-facilitated NGT meeting that generates a feeling of accomplishment not usually felt in meetings and a feeling of having had opportunity to express views, a participant can become even more frustrated when the results lead nowhere after the meeting. Some consultants have been quite successful in leading good NGT meetings with a feeling of accomplishment and a feeling of consensus and then escaping before participants attach any responsibility to the consultant for no follow up or follow through.

The key to true consensus is not only acceptance, but agreement and commitment. Agreement and commitment imply that people are willing and ready to follow up and follow through. One consideration as a facilitator is to get the group to define realistic expectations on the group's ability to follow up and follow through. To make something tangible happen, the group and its members need to be ready, willing, and able to carry out the actions implied by the decisions they make.

In my experience, I tell the group up front that NGT is good for idea generation and for efficient meetings and decision making. I also tell the group that idea generation is necessary but not sufficient for good consensus and that they have to work on consensus after the NGT part of the process. The NGT gets them part way there but not all the way to consensus. Groups understand and appreciate the truth and are thankful for any progress made in a meeting, thereby making NGT successful over the long haul. To move beyond the idea generation in NGT, the facilitator needs to be good at dealing with and resolving conflict and then moving on to consensus.

The NGT steps I'll discuss are shown in Figure 1.6.2.1.12.1. The first five are standard NGT steps. Steps six through eight are steps I've added over the years to make NGT more effective.

1. Silent generation of ideas.
2. Round robin offering of ideas.
3. Combination and clarification of ideas.
4. Voting and ranking of ideas.
5. Selection of high-priority ideas.
6. Sanity checks on high-priority ideas.
7. Sanity checks on left-out ideas.
8. Scoping of high-priority ideas.

Figure 1.6.2.1.12.1. *The NGT steps help a group creatively generate ideas and surface a high-priority list of ideas the group can support.*

1.6.2.1.12.2. IDEA GENERATION AND THE NOMINAL GROUP TECHNIQUE

NGT helps everyone contribute a large number of diverse ideas as a pool for selecting the high-priority ideas.

The first two NGT steps, silent generation of ideas and round robin offering of ideas, will encourage people to look within themselves for good ideas, without being affected by others. And then the participants will be in a situation where the ideas of other people will stimulate even more ideas from them. These two steps ensure that each person participates and that the participation is roughly equal. These steps help you, as facilitator, give all participants ample opportunity to express their views. When you do the round robin offering of ideas efficiently with the help of good people acting as recorders, you'll generate a level of excitement and expectation people aren't used to in meetings.

In silent generation (Step 1), the purpose is to generate as many ideas as possible, without any discussion. You want each participant to think of all possible ideas, from very general ideas to very specific ideas. Since there's no discussion, no person is influenced by any other person at this step. Those people who are more introverted or less apt to speak out can generate as many ideas as anyone else. One advantage of this step is that people aren't influenced by dominating personalities. You can also use machines that collect ideas anonymously in subsequent steps so people aren't fearful when generating more-controversial or possibly less-realistic ideas in this step.

Once people clearly know the issue under consideration, you should give the participants several minutes to write down their ideas. Don't give them too much guidance on what the ideas should look like, either in form or in substance. Any idea is worthy at this point. Different people have different experience, outlook, and personalities. So, you'll get a number of very different ideas. Some ideas will be general, some specific, some seemingly off base. All ideas help at this point to stimulate other ideas; and the group will cull out ideas that don't fit in later steps. Remind the participants that they can add to their list of ideas during the next step (round robin offering of ideas). Therefore, you don't have to wait the next step until everyone has written down everything they know. When you think each participant has several ideas written down, begin the next step.

In your group, you may have a participant who isn't used to being involved and who will sit back and watch. Remind everyone that in the next step you'll call on each person in sequence (perhaps starting at the front left-hand side of the room) to offer up one of his or her ideas. You'll find that the person who sits back will get involved sooner or later during the round robin step.

In round robin offering of ideas (Step 2), the purpose is to lay out all possible ideas for everyone to see and to stimulate new ideas as this step proceeds. The person who has been sitting back gets stimulated too. Unless we use a form of high technology, the way we show ideas is on flip chart paper, or we can use big Post-it notes. The facilitator recognizes each person in the room, one at a time, to offer his or her favorite idea—only one—and records the idea on the flip chart.

The facilitator will go around the room as many times it takes for everyone to offer all their ideas, one at a time. The reasons for offering ideas one at a time are to give every-

one a chance and to give people the opportunity to think of new ideas stimulated by someone else's ideas. Remind the participants that if someone else identifies his or her idea, it's okay; the idea is on the flip chart—that's all that matters at this point. Record all ideas. No idea is bad or silly, too general or too specific. If an idea looks like someone else's, ask the two offerers if the ideas are the same. If either participant says no, then record both. Allow no discussion during this step. The spoken words are for offering ideas and clarifying the process only.

As you go around the room, some people will either have offered all their ideas or will have their ideas offered by someone else. At that time, a person can pass; and you go on to the next person in sequence. When going around the room the next time, be sure to recognize each person who passed before. Often they'll come up with additional ideas because of something someone else offered. The purpose is to generate as many ideas as possible. When you have a lot of passes in group, by that time you can recognize people with a glance and they'll respond orally or with a head nod. You can move very fast now. At this point, people recognize the end is in sight and they'll perk up a little. When you get everyone to pass, you can stop this step. I've shown a typical flip chart page in Figure 1.6.2.1.12.2.

As you record ideas on the flip chart, be sure to leave room between ideas. In later steps, you'll want space to write some numbers. Five or six ideas on a flip chart page is enough. When you get to 50 to 70 ideas, you'll have ten to twelve flip chart pages taped up (or tacked up) around the room. Being surrounded by charts lends a strong sense of accomplishment. Remember, you'll always need individual idea numbers. Often, it's handy to record the name of the person offering the idea (especially in large groups). You'll need to identify the offerer later when combining and clarifying ideas in Step 3.

For tracking purposes, you should sequentially number the ideas offered. Depending on the concern for attaching a person's name to each idea, the facilitator can record the person's name with his or her idea. Actually, one way to help NGT be successful is to have one or two (preferably two) recorders to put the ideas on the flip charts. Good recorders are crucial. A good recorder hears well (doesn't have to hear an idea over and over again) and writes legibly very fast. The facilitator wants to move quickly around the room to keep everyone's interest. Participants are attentive to the offering of the idea but lose interest and will disrupt by starting side conversations if writing the idea takes time. The facilitator should feel almost like an auctioneer, encouraging bidding of ideas and giving everyone a chance and keeping up a pace and cadence that keeps people interested and involved. The facilitator has no interest in the ideas themselves, only in the involvement in and movement of the process.

Often, people will seek a facilitator who has content knowledge. I don't see great value in having content knowledge except for not misinterpreting jargon when you repeat the ideas for the benefit of your recorders. The facilitator is clearly in charge of the recorders and relays ideas quickly from the participants to the recorders. One recorder writes ideas 1, 3, 5, 7, etc. and the other writes ideas 2, 4, 6, etc. In Figure 1.6.2.1.12.2., I've shown the chart for the first recorder. The facilitator directs ideas by alternating this way to keep things moving faster.

If done well, this step is fun and enlightening for the participants. It's interesting to see new ideas flash up quickly and see the diversity of thinking in any group. You should expect from 40 to 80 ideas. At about five ideas per flip chart page, you'll get eight to 16 pages to hang around the room. Not only is seeing the ideas

fun, but seeing all the productivity implied in that many sheets of paper hanging in every direction around the room is fun too. This is the first of two high points in the process. As facilitator, you want to make the most of the good feelings at this step.

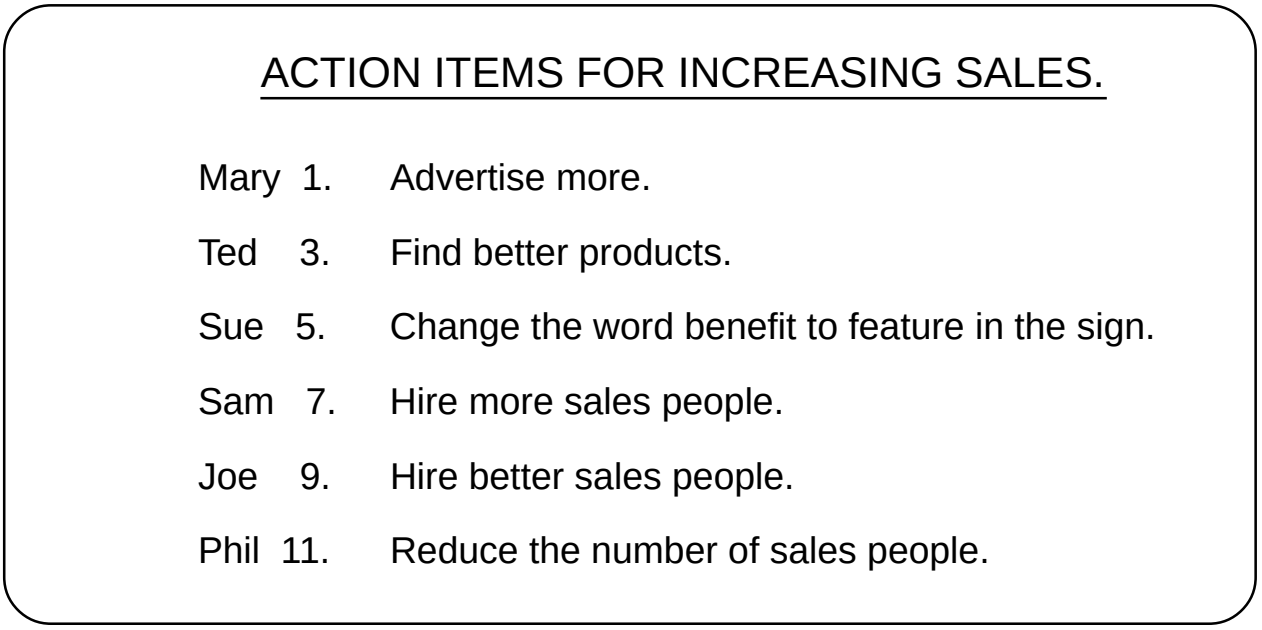

Figure 1.6.2.1.12.2. *The typical flip chart page shows ideas generated by sequence number and the name of the offerer.*

1.6.2.1.12.3. THE GET-IT-OFF-YOUR-CHEST STEP

Usually, people come to meetings with an issue on their mind. If a participant doesn't get his or her issue off his or her chest, that issue will distract them from the business of the meeting until he or she uses his or her issue to disrupt the meeting.

My experience is that, especially if a participant is a stakeholder in the objective of a meeting, any person coming to a meeting will bring baggage. That baggage can be bad history with someone or something related to the meeting's objective, a concern for the outcome of the objective, or a concern related to but somewhat distant from the meeting's objective. The participant will have his or her issue on his or her mind until you get the issue off. The participant can't get into the flow of the meeting and into the objective of the meeting as long as he or she is dealing with the issue. The participant wants to voice his or her concern. However, you really don't want to start off by getting all the dirty linen and conflict out on the table. The NGT can help you get through his problem.

According to the 7-P Model in Module 1.6.2.2.13.1., you'll have defined the meeting's objective (problem) and process before the meeting. You want to advertise both the objective and the process before the meeting and at the beginning of the meeting. By making the objective and process clear, you'll scope the meeting but you won't solve the problem of participants bringing their issues to the meeting. I suggest the following additional steps in the NGT (steps I've already discussed, but used for a different purpose) to clear the air and focus all the participants on the objective you want.

To clear the air, I tell people in meetings that we start by getting relevant information in front of the group—information that doesn't directly address the objective, but that is relevant. Recall the example issues for an NGT listed in Module 1.6.2.1.12.1. The first issue was, "What are the action items we need to accomplish to increase our sales by 20% this year?" A question that raises relevant information is, "What are the barriers to increasing our sales?" That one is bound to help people get issues of their chests. Another relevant question is, "Why do we need to increase our sales this year?" Questions like these aren't as specific and don't get to a solution like the statement of the issue. However, the generality of the question helps people feel whatever issues they may have on their chest will fit and promotes the participants getting the issues off their chests and onto the flip chart for everyone to see.

The second issue was, "What skills do management systems engineers need to be successful?" A question that raises relevant information is, "What courses should management systems engineers take in school?" When people address their skills and knowledge, they tend to think of the issues related to where and how they got the skills and knowledge they have. The relevant question opens the way for participants to get their issues off their chests.

The third issue was, "How can we find better programmers in a highly competitive market for good talent?" A question that raises relevant information is, "Where are there people who have programming skills?" Another relevant question is, "Why do we need better programmers?"

When you identify the relevant question, you should carry the group through the first two

steps of the NGT. You'll not only get the issues off the chests of the participants, but you warm the participants up to the process you're using. Also, if some of the participants have never done NGT, you'll be training them a little bit.

When you finish the first two NGT steps for the relevant question, you'll have five to ten flip charts around the room. As shown in Figure 1.6.2.1.12.3., the participants will feel like they've started in doing something in the meeting process. And, in fact, the relevant information will be relevant and can serve as additional stimulation of ideas as the group moves into the next steps of the meeting process.

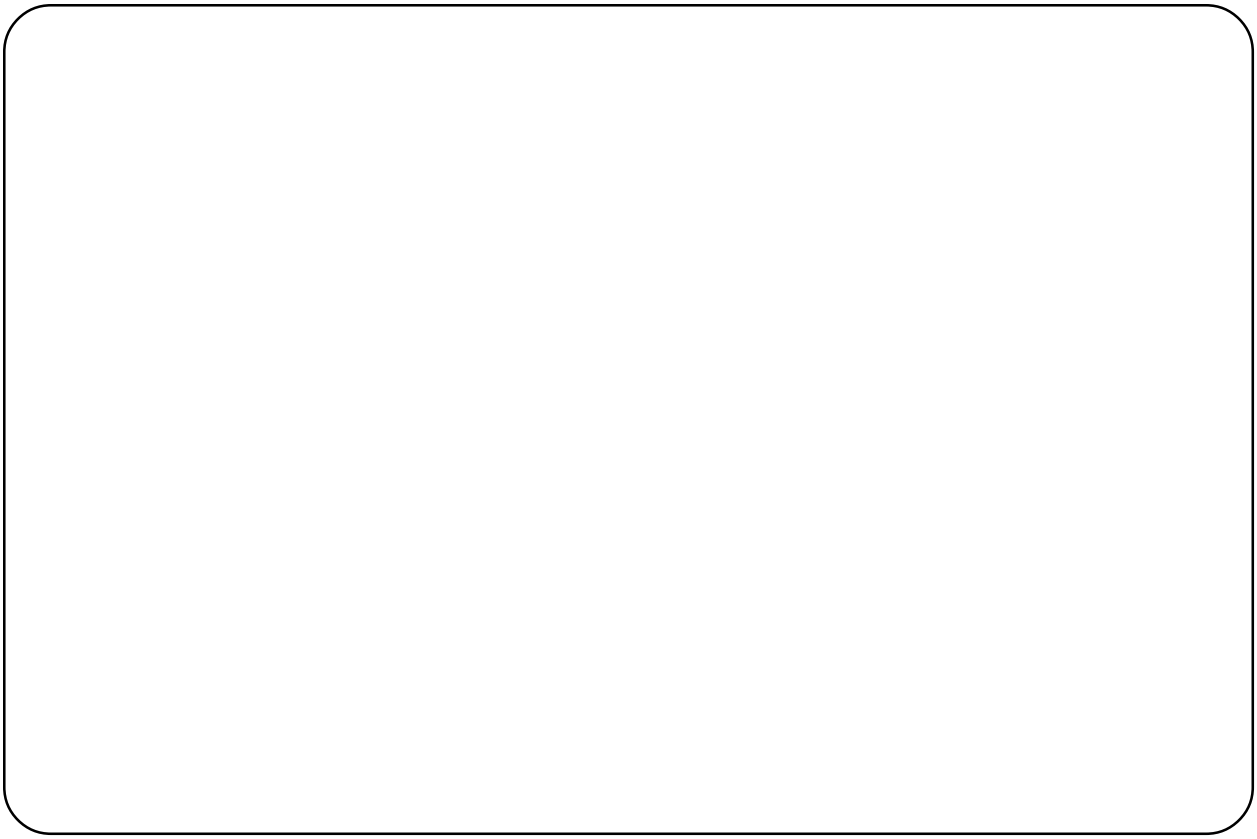

Figure 1.6.2.1.12.3. *When we are surrounded by tangible evidence of results from our work, we feel successful.*

1.6.2.1.12.4. SORTING IDEAS BY PRIORITY

The group will bring the high-priority ideas to the top for scoping, refinement, and action.

The second two steps, combination and clarification of ideas and voting and ranking of ideas, will encourage people to clarify and separate ideas so you can work on a tractable number of ideas. When you do the voting and ranking of ideas carefully and get to the point of tallying and recording scores to show participants where they fit into the group, you generate a level of excitement and expectation people are used to at sporting events.

In combination and clarification (Step 3), your objective is to gather ideas that are really similar and be sure not to lose or submerge anyone's offering. People don't like their stuff discarded. You must gather together ideas that are essentially the same. Also, you must not give anyone the thought his or her idea is gone. The way you accomplish this seemingly mutually exclusive pair of tasks is to ask the group to find similarities. In this step, the only discussion is to clarify an idea that someone doesn't clearly understand. You need to clarify now to be able to discern similarities. Don't allow anyone to make a pitch for his or her idea by saying something like, "We're only doing clarification here; you can show your enthusiasm for your idea in the next step." Do make sure people understand what the words of the idea mean enough to be able to contrast the idea in their own minds with other ideas.

If, for example, ideas #6, #21, and #47 are suggested by a participant to be similar, ask which seems to be the parent for the other two. Assume the participant suggests #21 as the parent idea. Then ask the offerers of the three ideas if they agree with the suggestion. If any of the three disagrees, leave his or her idea alone. If any of the three agrees, fold the other ideas under the parent by first putting a line through the number of the idea to be folded and listing that number next to the number of the parent. Put the number or numbers in the space you left between ideas on the flip chart. If the person offering #6 or #21 disagrees that idea #6 should be folded in, then leave #6 alone. If the people offering #21 and #47 agree #47 should be folded in, then show #47 under #21. The offerers may prefer #21 be folded in under #47. That's okay, of course.

Be sure to tell the participants that when they get the typed version of the proceedings, they'll see the parent listed with the other ideas listed in their entirety (the idea number and all the words) indented underneath. Tell the participants also that, when selecting ideas, they'll select the group of ideas as a package. In my example, #21 and #47 are considered a package. I like to use the term "folded in" for the ideas placed under a parent idea. The important issue is that no idea at this point is more or less important than any other. "Folded in" sounds to me more like a mutual occurrence among the ideas.

Some participants will get carried away by this step and, if you let them, will find similarities everywhere and tend to reduce the entire list down to a handful of superordinate ideas. Superordinate ideas are difficult to implement due to lack of specificity. The facilitator needs to guide the participants to just combine very similar ideas. The group will move logically through this step. That is, the group will do the combination job well for a while and then as time goes on will overdo the job. So, you should call time when the combination step gets essentially finished.

Make sure the group knows that someone will type out the list as combined and clarified as the raw data base of ideas from the meeting. Often in doing NGT, you can have someone bring a laptop computer, type as the process progresses, and provide a printout at any time during the process. If you don't have on-site typing and reproduction of proceedings, make sure each participant gets the results of this step and all the following steps soon after the meeting is finished. Make sure that each person who participates by offering ideas or later voting and ranking can see his or her contribution clearly and exactly. Rapid feedback of group results gives the participants a clear sense of progress and accomplishment.

In preparation for Step 4, voting and ranking, you can add a new step into the process. I don't include this step in my list of NGT steps in Figure 1.6.2.1.12.1. because it's not part of classical NGT and I almost never use the step. I don't use the step mostly because I'm almost never given enough time to do the process the way I'd like; and this is a step I choose to leave out. However, for completeness, I mention the step here. The purpose of the step is to get the participants to review all the ideas and to wrestle with what makes an idea high priority.

In this new step, you can ask questions about relevancy, usability, urgency, importance, resources required, political impact, etc. You can give the participants an exercise in placing the number for each of the ideas in a grid showing one of these measures against another; e.g., a relevance versus resources required grid. You don't need to worry too much about what's on the grid. You want the participants to review the ideas and to consider each idea against each other idea according to some measure. Then the participants are more ready to begin the voting and ranking step. The participants will do the exercise where they sit; and you don't need to gather or record any data on flip charts.

In voting and ranking (Step 4), your objective is to raise to the surface a group of high-priority ideas. Be very careful you don't think or the participants don't think that in doing this step you have a true ranked list of ideas. You'll use one of several methods to get people to vote on the combined and clarified ideas. Through their voting, you'll get numbers that yield data but not decisions. This step is an opportunity to make or break the process. If people think that the data from the vote is consensus, you're in trouble. Voting doesn't yield consensus; voting yields data.

Remember that strength of consensus can vary. Strong consensus implies higher-confidence results. Strong consensus implies acceptance, agreement, and commitment. Americans are pretty good at acceptance of the results of voting. But, do you necessarily agree with someone if you have voted for him or her? And even more importantly, are you necessarily committed to him or her just because of your vote? And if you voted against him or her, what's your level of agreement and commitment?

I've facilitated groups where one of the ground rules was that nothing came out of the group that wasn't unanimous. One group included 15 lobbyists who represented opposing constituencies. Believe it or not, the results were good. It took time because the group had to refine all their thinking to the point of separating out what they could and couldn't agree on. Most people will agree most of the time. However, most people like to focus on their disagreement. By focusing on their agreement and agreeing to separate out and hold respectfully their disagreement, the group accomplished a lot. This was a hard job; and NGT wasn't nearly enough, but I often used individual steps of the NGT.

A technique I often use to deal with disagreement, important but tangential ideas, or other

related but distracting issues is to list the disagreement, tangential idea, or distracting issue on a separate flip chart. Sometimes I call that flip chart "the parking lot" to give participants the notion of setting an idea aside for a while and not putting the idea away or discarding the idea. Using this technique, you can deal with participants' actions that can be disruptive, distracting, or delaying.

In the voting and ranking step, pass out five to nine 3 x 5 cards, depending on how many ideas the participants have to choose from. Each card should have a line for the idea number in the upper left-hand corner, lines for the words of the idea in the middle of the card, and a line for the ranking of the idea in the lower right-hand corner. Use five cards for 30 to 50 ideas resulting from Step 3 (combination and clarification of ideas), seven cards for 50 to 70 ideas, and nine cards for 70 or more ideas. I've shown a typical 3 x 5 card layout in Figure 1.6.2.1.12.4.

Each participant should take his or her cards (assume for this example, seven cards) and write one idea on each card. The participant should write one number (the parent number for combined ideas) and a few words of the idea (for verification, if necessary) on each card and end up with seven cards with a total of seven ideas. The participants shouldn't write anything on the ranking line in the lower right-hand corner of the card yet.

After each participant has completed his or her seven cards, he or she should rank his or her seven ideas in sequential order, with a seven ranking for his or her favorite idea. Don't define favorite as most important, most urgent, or other characteristic. Let each participant interpret favorite for himself or herself. There are a number of ways to rank the cards. Supposedly, the scientific way to do this part of the step is to identify the most favorite idea and assign a rank of seven in the lower right-hand corner of the card. Then identify the least favorite idea and assign a rank of one on the card. Then, for the remaining five cards, identify the most favorite of that group and assign a rank of six and identify the least favorite with a rank of two, and so on. I do the job differently. I lay my seven cards out in front of me in any order and then by pairwise comparison keep moving cards until I see them all together in the sequence I like. Then I rank them in sequence from a high of seven to a low of one.

During this step of the process, everyone will mill around to read the flip charts more clearly, to stretch, to think better, or whatever. When they finish writing the seven ideas on their cards and rank the cards, they should give their packages of cards to you for you to collect and tally the data. Since everyone moves at a different pace and everyone is milling around, you should announce before starting everyone on the step that when a person has finished the step and given his or her cards to you, they should take a break. But, be sure to tell the participants that as you get the cards you'll be tallying the results and have the results of their voting and ranking posted on the flip chart pages when they return from their break. Knowing they'll soon see results, participants will keep their breaks short to get back to see the results unfolding.

This step is the second of two high points in the NGT process. The participants will be glad to be able to move around some. Most of all, people love to see the results unfold on a scoreboard. It's the American way. Everyone loves to see one idea ahead for a while only to be overtaken by another and to see how well the ideas they voted for fare. While you want to make the most of the fun in this step, you have to keep reminding yourself and the participants that the idea that has the highest score isn't necessarily the highest-priority idea. However, you will find that ten or so ideas will

clearly form a top group—a group of higher scores. The voting and ranking usually generates a top group, a large middle group, and a bottom group. Usually the ideas in the bottom group get no votes or maybe one vote.

When you tally the results, you want to track and record both the number of votes and the total score for each idea. Use the space you left between ideas on the flip chart to record the results. You must show both the number of votes and the total score. You may want to include the list of individual votes. For example, assume idea #21 (with #47 folded in) gets votes of 7, 7, 5, 3, 3, 2, 1, 1, 1. You track and record 30/9. This score isn't an average of 3.33. This score is a total of nine people voting a combined score of 30. Write the score 30/9 under the idea #2 in a different color from the idea list. Write the scores under each idea number. You'll likely find some interesting results. The participants will be fascinated with what they've done.

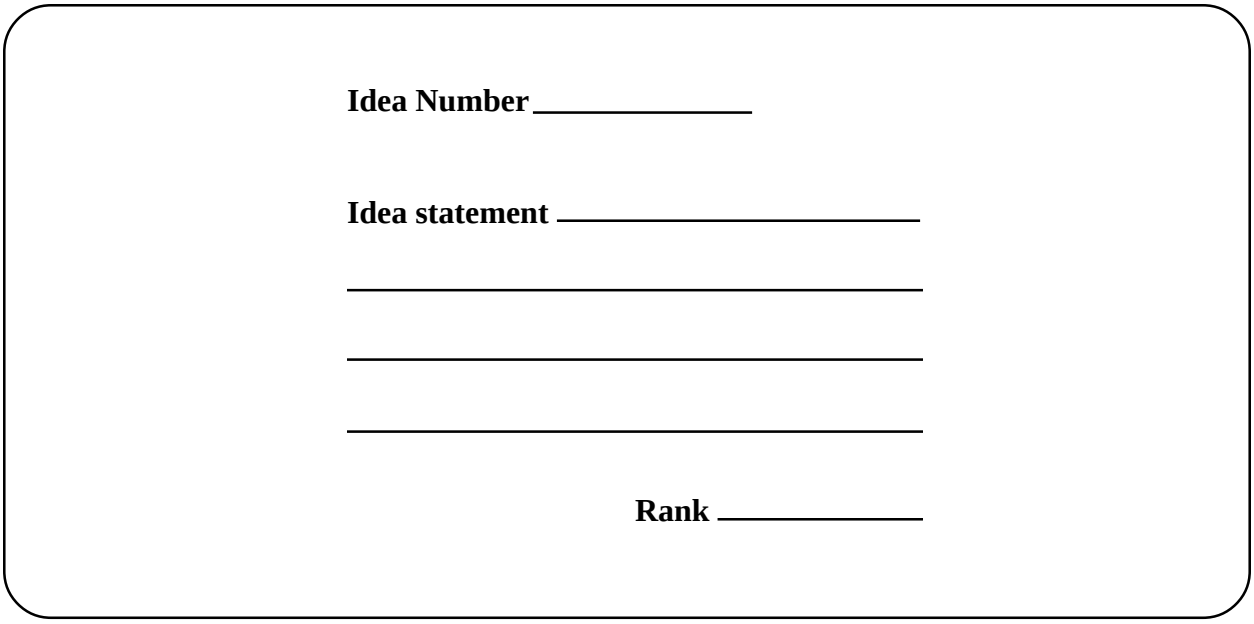

Figure 1.6.2.1.12.4. *The typical 3 x 5 card includes space for the idea number, a few words from the idea statement for verification, and for the ranking of the idea.*

1.6.2.1.12.5. GETTING THE IDEAS TO WORK ON FIRST

The objective of the process should be to get the group to accept and possibly to agree on a list of a doable number of ideas from their long list to work on first because those ideas are of higher priority to the group of participants.

The fifth step of the standard NGT plus the first two of my added steps are needed to separate out from all the ideas generated those ideas that are doable, are of higher priority than the others for the group of participants, are somewhat challenged. You want the group to challenge ideas (especially the higher-priority ideas) to ensure the group feels good about their set of higher-priority ideas, the ideas are at least acceptable to everyone, and, hopefully, everyone agrees these are the ideas to work on before tackling the others. The important situation now is that participants will have (or will soon get) a ranked list of the large number of ideas they've generated. However, some of the ideas are out of bounds, are infeasible, or are low priority. If the group believes time and resources will be spent on some of the ideas, they'll be concerned that the right ideas get time and resources first. As facilitator, your job is to surface those ideas that should be considered higher priority by the entire group and that the entire group will support after the meeting and during the weeks or months when implementing the ideas confronts the many distractions of the typical workplace.

The fifth step of the standard NGT, selection of high-priority ideas, produces a draft list of higher-priority ideas. The first two of my added steps, sanity checks on high-priority ideas and sanity checks on left-out ideas, help generate a more-finished list of high-priority ideas that you'll have a bit stronger consensus on. Be careful. Even though the consensus is a bit stronger, it's still not real strong. Why? Because you won't raise and resolve conflict.

Raising and resolving conflict takes much more time and much more facilitator skill than does the NGT. (The key step in contentious meetings where confrontation, emotions, and conflict are expected is to first participatively generate a list of ground rules for proper behavior, facilitator authority, and moving the process forward.) Whether you expect a meeting to be contentious or not, if you want consensus, you'll have to deal with confrontation and conflict.

In selection of high-priority ideas (Step 5), you'll engage the group in surfacing a reasonable number of ideas the group wants to work on first. As you look at the scores written under each idea, don't look for sequence. Look for groupings. For example, idea #21 may get a score of 30/9 and idea #3 a score of 28/10. Which is higher priority—the one with higher total score or the one more people voted for? Now you're beginning to see why you can't say one idea is higher priority than an idea with a similar vote. You can however, say that an idea with 30/9 is higher priority than an idea with 2/1. So, if you look at the list you can isolate what looks like the top group of higher-priority ideas. I suggest that you write the letter A next to ideas with relatively large numbers in the numerator or denominator of the scores. Write the letter C next to ideas with low numbers in the scores, and write the letter B next to the middle group of ideas. Be careful not to think or to let the group think that these letters clearly demark ideas of greater or lesser

worth. You'll get about ten A ideas, ten C ideas, and the rest B ideas.

You still can't be sure that one of the ideas in the A list wasn't an unintentional or intentional block vote by a clique in your group or that one of the ideas in the B or C lists really belongs in the A list. You do have a good feeling that the majority of the ideas in the A list belong there and the majority of the ideas in the B and C lists belong there. The next steps will help you deal with these issues. Without the next steps, you run the risk of someone recognizing the issues I've just raised or other issues that will render your result meaningless and unsupported by the group over the long haul.

At this point, you want to start saying, "Is this set of ideas (the A list) the ideas you want to work on first?" or "Is this list of ideas what you together believe are higher-priority for now?" Ultimately, you want to look each participant directly in the eye (no kidding) and have him or her clearly signify, "Yes." But you may not want to force the issue before you consider the next two steps. (For contentious meetings, the technique of looking each person in the eye for concurrence is a facilitator role to be clearly defined in the ground rules.)

These five steps (silent generation, round robin, combination and clarification, voting and ranking, and selection of high-priority ideas) completes the steps in the standard NGT, at least in terms of how I've done them and the experiences I've had. At this point you have a ranked list of ideas. Some facilitators will numerically number the ideas according to the scores and the vast majority of groups will let you get away with this practice—at least during the meeting. After the meeting, if any of the participants feel uneasy in their gut, they won't actively support the result.

The next steps will get people to feel better about the result and will yield something that smells more like consensus. But, without raising, dealing with, and resolving conflict, you aren't at consensus yet. You might want to call the result weak consensus; but, I strongly suggest you discuss this issue with the group to make sure everyone has realistic expectations.

In sanity checks on high-priority ideas (Step 6), you want to get the group to wrestle with the A list of ideas as a package and first determine if any of the ideas doesn't belong. In my experience, you often find one idea the group agrees to drop from the A list. Sometimes you'll find two ideas. This experience reinforces my notion that the voting and ranking step doesn't generate consensus.

I'm a bit uncomfortable with the term "sanity check," but I use the term anyway. You should tell the group that voting and ranking gave the group data to generate the draft A list of ideas. Now you want the group to generate more data to challenge the A list. Remind the group that the A list is now their focus. The A list is of reasonable size and you'll note is of reasonable substance. That is, the will of the group has filtered the ideas to eliminate unworkable, facetious, mischievous, or unreasonable ideas. The A list is a wonderful start. I've never been disappointed in the workings of the group. You may have some strange people or strange ideas in the meeting. However, the group takes care of itself and the group result is good. The convener of the group (usually a supervisor) might think he or she has a better set of ideas for the issue. (I'll bet the overlap between the convener's list and the group's list is great.) However, if the group or the constituencies represented by group members are to be part of the implementation of the ideas or will have the implementation done to them, you'll get better results if you choose the group's list over the convener's list. See Module 1.6.2.1.13. on calculating whether your solution is better than the group's.

Tell the group that in the sanity checks you're adding data to the voting and ranking results for the participants to challenge their A list. My favorite sanity check is to highlight each idea in the A list, one idea at a time. Ask a show of hands (or other voting method) of those who believe this idea really belongs in the A list. Record the number of votes divided by the number of participants next to each of the A list ideas. You're checking plurality. If fewer than half the people in the room believe the idea belongs, its place in the group is challenged. Now comes the consensus piece. I go around the room one at a time and look each person in the eye and ask, "Do you think this idea should be dropped from the A list?" If any one person says, "No.", I leave the idea in the list. I personally believe that messing with the A list requires unanimity. I, of course, suggest the rule of unanimity to the group and discuss the issue of consensus before I do the look-in-the-eye thing. You need to get the group to realize that it's the A list you're focusing on and that no idea in the list is more important than another at this stage. This focus changes the participants' outlooks and they don't feel an idea in the A list is threatened. I've never had a group with a problem in the unanimity rule for sanity checking.

You may think of other ways to ensure that the group doesn't keep an idea in the A list that shouldn't be there. You don't want the group to get in an "Abilene" condition started by the voting and ranking step. See Module 1.6.2.1.11. for what I mean by Abilene.

In sanity checks on left-out ideas (Step 7), I'm interested in the reverse situation. We checked for what's in the A list that should really be out. Now we check for what's out that should really be in. Again, you want to suggest the unanimity rule.

Ask the group if anyone sees an idea that somehow didn't get many votes but really belongs in the A group. You run a risk here of someone with a pet idea pushing for his or her idea to be included. However, the group is pretty well conditioned at this point to the notion that only talk for clarification is needed; and I haven't experienced many passioned monologues for an idea. I have experienced a real sanity check in this step. I've seen ideas resurfaced that somehow the group knows belongs in the group but didn't vote that way. I've even had ideas from the C list move into the A list. The unanimity rule takes care of pet ideas that don't belong. And retrieving an idea for the A list gives participants a feeling of security for all ideas not on the A list.

Now, you have a better draft of the A list and a little bit stronger consensus. I show an A list in Figure 1.6.2.1.12.5. The unanimity rule seems to bring more agreement to the list. The next step, and usually my last step, brings more sanity and another level of understanding and consensus to the list.

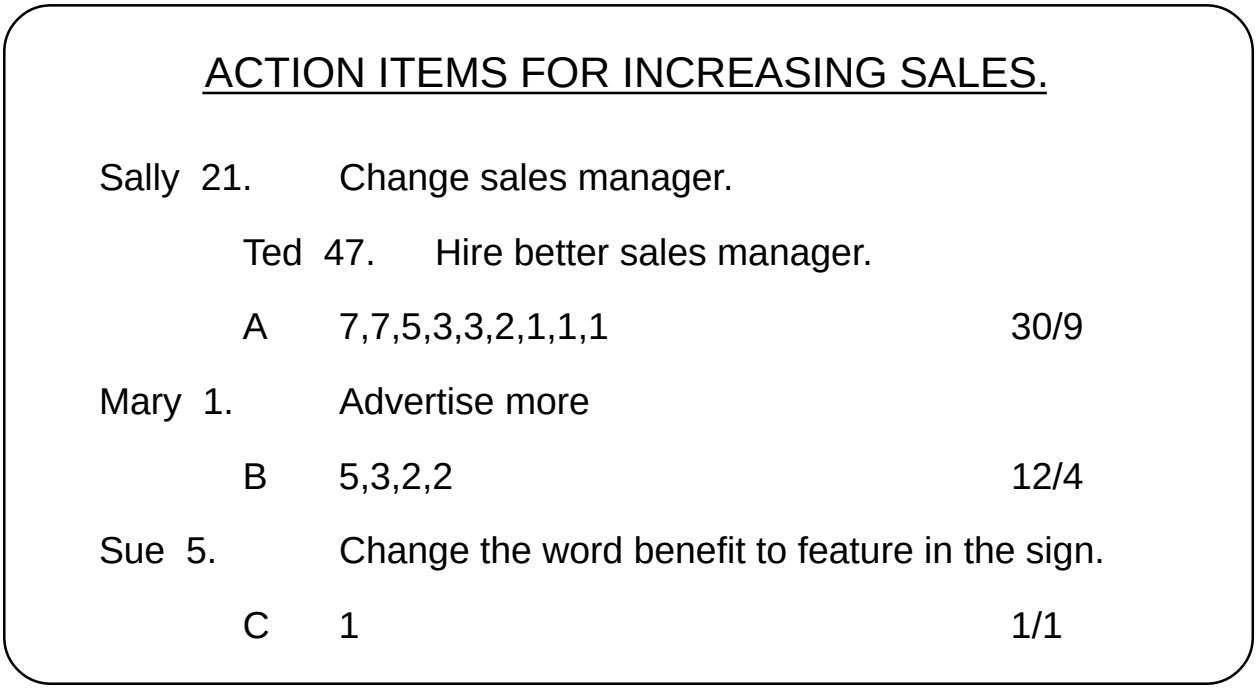

Figure 1.6.2.1.12.5.1. *After voting and ranking, the flip chart page includes the ideas folded in other parent ideas, the votes, the tallies, and the list designation (e.g., A list).*

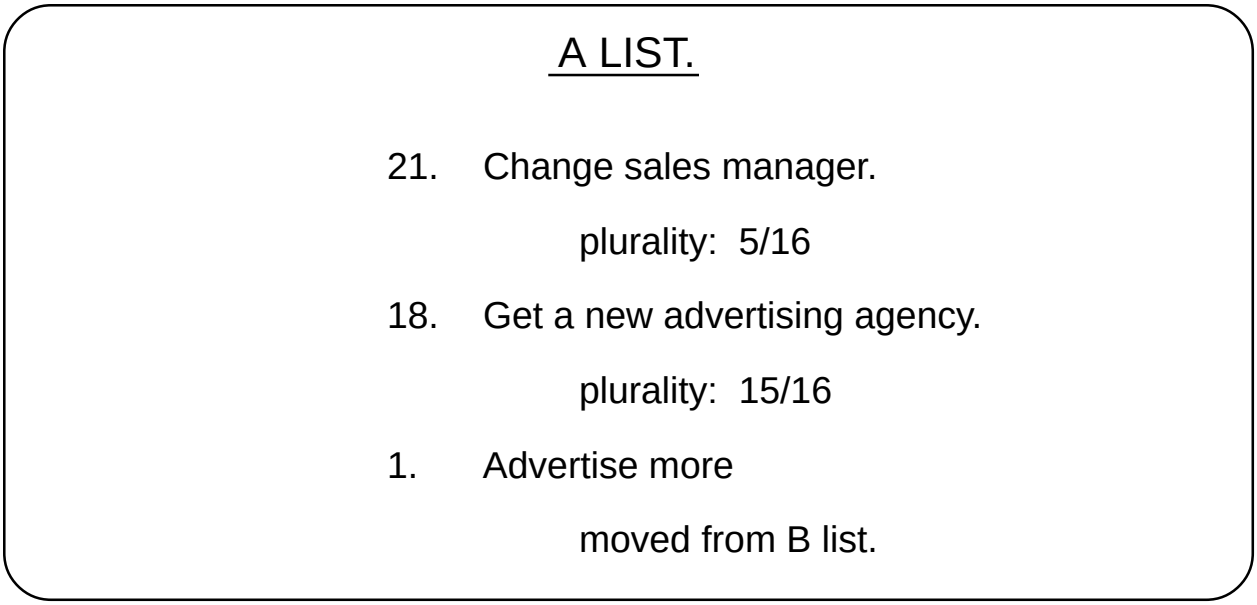

Figure 1.6.2.1.12.5.2. *The flip chart showing the A list allows for additions and deletions resulting from sanity checks.*

1.6.2.1.12.6. Finding Out What It Takes to Implement the Ideas

When the group reviews the scope of each of the higher-priority ideas, the participants cement their agreement and begin on commitment through accountability.

After you have an A list, you need to consider next steps. The first next step is to scope each higher-priority idea on the A list to determine feasibility, to assign responsibility and due dates, and to give the responsible person a head start in scoping the task related to the idea based on the understanding of what the idea means the group attained during the meeting. In fact, this step can be yet another sanity check. That is, if scoping the task shows the implementation of the idea to be infeasible given the situation or resources available or that implementing one or two ideas means no time or resources for the many other ideas, the group can decide to hold the idea aside to accomplish the many other ideas.

Often, the facilitator can help the group come to closure. Especially a nominal group has trouble coming to closure. For example, you can identify and suggest action on action items that come up during the meeting. The key to action on action items is determining the responsible person and due date. You can identify and verify decisions made that extend beyond the process of the meeting. I see these interventions as process interventions and, therefore, within the purview of the facilitator. As you make these kind of interventions, the group will get into the swing of it, and, before long, the participants will identify action items and decisions made.

To do the scoping step, have the participants group themselves into small teams. Each team will take one idea and scope the idea in terms of objective, impact, time, and resources. Have the teams go to breakout spaces and brainstorm and document the scope of the task. Have the teams select a spokesperson to report back to the larger group. Have the spokesperson make his or her report to the group. Have the team record feedback from the larger group. Figure 1.6.2.1.12.6. is a form I use to help the scoping team cover needed issues around implementing an idea. Collect the forms with feedback and have them typed. Pass this information on to the person responsible for implementation.

Now, you must help the group follow through. Have the group decide if they intend to meet again and what the objective of their next meeting is to be. An example objective could be to hear from the implementation teams implementing the ideas so the group can have some input. Another objective is to reconvene at some regular time (e.g., quarterly or annually) to generate a new A list. Since the world is continually changing, the A list may need to reflect the changes. Also, as ideas on the A list get implemented, the participants may want to elevate ideas from the B list to be implemented.

Scoping Form for Action Items

ACTION ITEM NAME_____DATE_____

Scoping Team Leader:

Scoping Team Members:

1. Define and Describe. Write down a concise, comprehensive statement of your action item.

2. Define objectives/desired outcomes.

3. Define the expected benefits. To whom?

4. What has to be done? Try to lay out general steps.

5. By when should it be done, and why is the date important? When should it start to make the deadline? What are major milestones?

6. Who should be involved for contribution and/or implementation?

7. Are there people/groups to coordinate or cooperate with? If so, when?

8. What will the action item cost in funding and materials?

9. What are the potential risks from considering and/or implementing the action item?

10. Establish measures of performance: How will we know we have succeeded? How will others know/be persuaded?

11. Actions: What follows form this scoping?

Figure 1.6.2.1.12.6. *The scoping sheet gives the breakout groups direction on what to consider to ensure the total group knows what the idea will require for implementation.*

1.6. Group Decision Making

1.6.2. Group Decisions (More than Two)

1.6.2.1. Information Sharing

1.6.2.1.12. Nominal Group Technique

1.6.2.1.12.7. Experience With the Nominal Group Technique

1.6.2.1.12.7.1. Description of the Experience for Determining Needed MSE Skills

Include general information on the vision of the department and other information that will give good background.

ISE Vision

The vision for the ISE Department is influenced by the environment in which it must function. This environment currently presents extraordinary challenges due to diminished public and government support, increased accountability, and public expectations concerning improved productivity and lower tuition increases. The ISE Department welcomes these challenges and is committed to utilizing innovative and creative systems, technology, and processes to:

- Improve the quality of instruction and advising that are integral to comprehensive curriculum reform now underway.
- Enhance (funded and unfunded) research activities and their dissemination to address the needs of society.
- Improve degree productivity, student support base, and enhance students' likelihood of degree completion.
- Update the educational experience to encompass a global outlook.
- Address the needs of the nontraditional student.
- Maintain a continuous improvement program for faculty, staff, curriculum and facilities.
- Maintain high academic standards commensurate with the long-standing high reputation of Virginia Tech.

Mission Statement

Department of Industrial and Systems Engineering

The faculty of the department is committed to advance the state of the art of the discipline and to communicate existing and new subject matter to students, both undergraduate and graduate. The faculty is also responsible for both the broader education and intellectual growth of students.

Objectives:
The field of industrial engineering embraces a broad spectrum of technical activities including the classical techniques of work methods, production and facilities planning, quality control, and safety. It also embraces the fields of human factors, operations research, manufacturing systems, and organization and management systems, with the latter four fields well defined at the graduate level. Within this framework, the major objectives of our educational programs are as follows:

1. To provide a quality education that will prepare our undergraduate and graduate students for a life-long learning experience in this rapidly changing field and to prepare these students to be future leaders in the industrial engineering profession, in business, and in industry.

2. To conduct basic and applied research to advance the frontiers of engineering and to support the industrial and economic growth of our state and nation.

3. To provide service to the profession, industry, and society to contribute to the advancement of civilization and the betterment of all.

Principles
- Faculty will be committed to the teaching of students.

- Monitoring and improving the quality of instruction and verifying the relevance of our curricula, at both the undergraduate and graduate level, will be an ongoing responsibility. Our students are entitled to no less.

- The total education of the student, as he or she prepares to enter the profession and society, is also an obligation.

- Faculty will be committed to research both for their own professional development and to advance our understanding of the discipline of industrial engineering.

- Research funding and the return of overhead funds accruing from research contracts are important to the well being of the department.

- Faculty will share their research results and facilitate instruction across the discipline through presentations at national and international conferences, and publications in scholarly journals, wider read professional magazines, and textbooks.

- Public service is another obligation and a specific component of the land grant mission of the institution.

- An intelligent, competent, and articulate faculty will be a continuing priority. Toward that aim, the recruitment, development, and retention of faculty colleagues will be a shared responsibility.

- The attraction of undergraduate and graduate students of high academic potential is important to the well being of the department and the discipline.

- Modernization and well-equipped laboratories are important to our success in instruction and research.

- Funds from the private sector are necessary to supplement state appropriations.

- To be a part of a learned profession is a high calling and includes, in addition to high principles and a commitment to seek out truth, a shared respect for colleagues and a diversity of points of view, along with a genuine interest in and support for the students entrusted to our care and education.

The following formal definition of industrial engineering has been adopted by the Institute of Industrial Engineers:

> Industrial Engineering is concerned with the design, improvement, and installation of integrated systems of people, materials, information, equipment, and energy. It draws upon specialized knowledge and skill in the mathematical, physical, and social sciences together with the principles and methods of engineering analysis and design to specify, predict, and evaluate the results to be obtained from such systems.

Program Objectives

The ISE Department has as its general objective to provide a superior educational opportunity for qualified students coupled with strong research and extension programs to serve the needs of the Commonwealth of Virginia, the nation and the world. To accomplish this objective the department combines a "hands-on" educational philosophy in conjunction with a systems approach in addressing instruction, scholarship, research and extension in a manner consistent with the stated mission of the College of Engineering. The College of Engineer's position on these areas is stated as:

> "Instruction: to provide, in an environment conducive to learning, the instruction, guidance, and encouragement necessary to insure that each graduate will possess a foundation of knowledge, skills, and ethics essential to his or her progressive and continued development throughout a career in the engineering profession.
>
> Scholarship: to provide the resources and the environment in which faculty and students can achieve academic excellence.

Research: to provide the facilities, faculty, and staff necessary to attract sufficient research funding so that we can continue to perform as a major research institution known for quality research which has significant impact on the practice of engineering.

Extension: to provide the widest possible dissemination of the engineering knowledge gained through study and research and to assist wherever possible in the practice of engineering."

The manner in which the objectives are addressed in the undergraduate curriculum include:

1. Concentrate On The Functional Areas Of Industrial Engineering As Historically Defined: Examples of these well-known functional areas are cost effectiveness (engineering economy and cost analysis), facilities planning and material handling, manufacturing, work measurement and methods engineering, production planning and control (include forecasting, scheduling, and inventory control), human factors, and principles of organization and management. However, the methodology used for analysis in these subject areas includes operations research models and the exercise of systems philosophy, as well as the "traditional" tools (note Section XI.E.).

Although a substantial majority of the undergraduates continue to be employed by industrial and business firms, an increasing number of graduates are hired by a variety of service organizations such as banks, hospitals, major accounting firms, consulting firms, and research groups. Additionally, governmental, military, and educational organizations offer employment opportunities for the industrial engineering graduate. Thus, a primary emphasis on functional areas provides a more flexible educational base than a curriculum structured with purely "applications" courses.

2. Provide A Balanced, Or General, Curriculum: In consonance with the first objective, the functional areas identified above are defined as traditional industrial engineering. By integrating additional, required basic courses in statistics and probability theory, deterministic and probabilistic operations research methodology, and simulation, a balanced curriculum is thus defined. This balanced undergraduate industrial engineering curriculum also retains a fundamental physical and engineering science base (note Section XII.E.).

3. Provide Curriculum Flexibility: Since the practicing industrial engineer is a disciple of change, a minority portion of the undergraduate curriculum should be sensitive to new horizons or contemporary approaches to traditional problems. The recent national emphases on energy conservation and automated manufacturing are cases in point. The ISE Department believes this objective is accomplished by incorporating 12 credit hours of departmental and non-departmental technical, senior approved, and free electives, taken during the senior year, into the required credit-hour curriculum. These electives, plus a judicious choice of required humanities electives, provide an opportunity for (1) undergraduate specialization or (2) more specific preparation for entrance into graduate degree programs. However, the department's philosophy is to control the number and scope of electives (note Section XII.E.).

4. Emphasize Communication Skills, Both Verbal And Written: The successful, practicing industrial engineer must have the ability to communicate effectively at different organizational levels, a fact documented by history and current feedback from the market-place. Individual (or

group) projects and in-class presentations, a standard practice in the ISE curriculum, serve to develop this ability. Further, students are required to take Technical Writing, ENGL 3764 and may elect, and are encouraged to elect, formal communication skills courses as approved electives (note Section XII.K.).

5. Emphasize The Use Of The Digital Computer In The Industrial Engineering Functional Areas: Section XII.L. describes the ISE students' usage of the digital computer.

6. Encourage Professionalism: Attempts to accomplish this objective are made through departmental and individual faculty support of IIE, SME, Human Factors Society, SOLE, ORSA and Alpha Pi Mu student organizations. Further, both academic and non-academic guest lecturers are invited to speak to undergraduate classes. The ISE Department has found that an Advisory Board, with both academic and industrial members, has been very helpful in promoting an environment of professionalism within the department. Further, a policy of encouraging students to serve as regular members of certain departmental committees allows a continuing faculty-student interchange of ideas and results in joint work on departmental projects. Such cooperative effort on behalf of faculty and students has stimulated mutual respect, unanimity of purpose and, in general, fostered a professional atmosphere within the ISE Department (note Sections XIV.A., XIV.B., and XIV.G.).

Action to Correct Previous Weaknesses

There were two specific areas addressed in the last accreditation visit with required action by the department, within its capacity to respond. These will be addressed separately in the following paragraphs, the first being addition of space for the program including the manner in which the added space has been integrated with the department, and second changes in staff.

Space remains a concern and a priority item within the department, however, progress has been made and immediate future developments appear promising. Improvements have resulted from an increase in the space available to the department and in renovation of existing space that has resulted in a better use of space (note Sections XIII.A. and XIII.D.). The most significant addition of new space is the 17,200 net square feet of new space in the recently completed fifth floor of Whittemore Hall. The departmental space in Whittemore Hall is approximately one half of the first, second and third floors and all of the fifth floor. The Manufacturing laboratories and faculty offices occupy the first floor, the records office and faculty offices are located on the second floor, the human factors laboratories and offices occupy the fifth floor and the department office and remaining faculty offices and facilities are located on the third floor.

The expansion of Whittemore Hall has added substantially to the human factors laboratories and also has added 4,100 square feet to the manufacturing instructional laboratories, almost doubling their size. In addition, the manufacturing laboratory space was entirely renovated at a cost of over $100,000 to assure the additional space would be both appropriate and effectively utilized. New undergraduate instructional laboratories were developed in the areas of programmable controllers, automation, advanced automation, and robotics.

1.6.2.1.12.7.2. Silent Generation of Important Courses

Please identify and list below the courses, by title (and number if known) you believe are the most essential to the ISE curriculum. The courses you select don't have to be in the ISE department.

1.6.2.1.12.7.3. Round Robin Offering of Ideas for Important Courses

We'll now go around the room soliciting your ideas one-at-a-time and will write them on the flip charts for everyone to see. We'll continue until all your ideas are on the charts.

1.6.2.1.12.7.4. Combination and Clarification of Ideas for Important Courses

Look at the list of ideas generated in the round robin step. Do you understand what each one means? Do some ideas express the same idea and can therefore be grouped together?

1.6.2.1.12.7.5. Silent Generation of Needed Skills

Please identify and list below the concepts and skills you believe important for industrial engineering students.

1.6.2.1.12.7.6. Round Robin Offering of Ideas for Needed Skills

We'll now go around the room soliciting your ideas one-at-a-time. We'll continue until all your ideas are on the charts.

1.6.2.1.12.7.7. Combination and Clarification of Ideas for Needed Skills

Look at the list of concepts and skills generated in the round robin step. Do you understand what each one means? Are there some ideas that express the same idea and can be grouped together?

1.6.2.1.12.7.8. A Relevance/Resources Required Grid for Ideas for Needed Skills

Relate the relevance of the presented concepts and skills and the resources required to implement them. As you consider the list of all the concepts and skills generated by the group, a relevance/ resources-required grid helps you silently rank the items. The grid is on the next page. Everyone will not only view the list differently, but will also have different measures of the relevance of the concept or skill to industrial engineering students and the requirements for resources (e.g., faculty, laboratories, etc.) in implementing them as part of the ISE curriculum. The grid is personal, for you to place the numbers of the items from the charts produced in the round robin step. You'll have a representation of how you feel about the relevance of and resources required to implement the concept or skill.

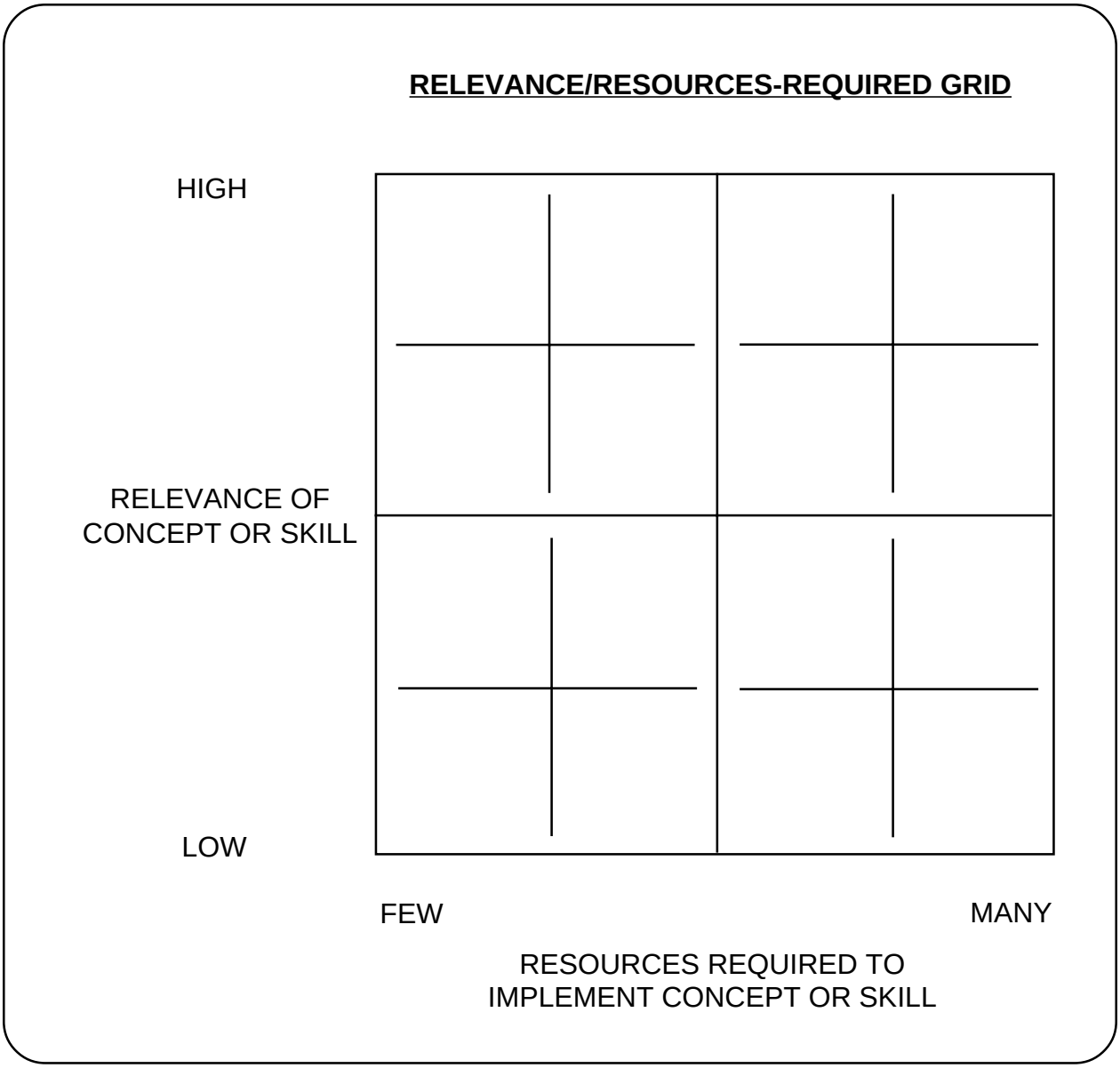

Figure 1.6.2.1.12.7.8. *Relevance/Resources-Required Grid.*

1.6.2.1.12.7.9. Voting and Ranking of Ideas for Needed Skills

There are several ways you can vote on and rank the ideas presented in the round robin step and then combined and clarified. How you do this is subject to your preference. The initial steps are common to all methods. Pick your top seven ideas from the lists on the charts. Write the idea number in the upper left corner of the 3x5 card and a short statement of what the idea is on the cards. Once you've identified the ideas for all seven cards, lay out your cards so you can see all of them. Here are ways to rank your seven cards.

1. Developers of the NGT suggest that you pick the most important of the seven ideas. Give this idea a vote of 7 and put it aside. Then pick the least important of the remaining six. Give that one a vote of 1. Keep alternating from most important to least important until all cards have a vote.

2. Lay out all your cards in front of you. Arrange in order of most important to least important using whatever means you wish. Give the most important item a vote of 7, next important a vote of 6, and so on to the least important with a vote of 1.

1.6.2.1.12.7.10. Selection of High-Priority Ideas for Needed Skills

The facilitator will summarize the NGT results and point out the high-ranking items.

1.6.2.1.12.7.11. Sanity Checks for Ideas for Needed Skills

We'll do a couple of sanity checks against our A list. First, we'll check each idea on the A list by asking our group to signify whether he or she thinks that idea belongs on the higher-priority list. We'll tally the total number of people who think so. Second, we'll ask the group if any idea not on the A list should be put on the A list. If we get unanimity, we'll add the idea.

1.6.2.1.12.7.12. Scoping Documents for High-Priority Ideas for Needed Skills

We could divide our larger group into teams and fill in the form from Module 1.6.2.1.12.6. In doing this step, we'd see the difficulty in converting the idea into action for implementation

1.6.2.1.13. EXERCISE ON PARTICIPATIVE DECISION MAKING

The probability of making a decision that results in a lasting effective action increases when we make a collaborative decision among those affected by the decision.

Explanation
We learn from the Management System Model (MSM) that to be of value, a decision must have an action that affects the work process. In the traditional organization, the person making the decision does not carry out the action to implement the decision. In fact, seldom does the decision maker check up to make sure his or her decision is carried out. That is, there's no follow through and follow up on decision making. However, if decisions are made collaboratively, the follow through is automatic and the follow up unnecessary.

The idea of this exercise is for you to convince yourself that whether you're an expert or generally lucky or you can find a consultant who is an expert or generally lucky, you don't want to make decisions based on expertise or luck alone. I want you to answer the question: Why implement the group's idea when you know (suspect) your idea is better? In short: Which is better, decision quality or consensus?

Situation Description
Sally and Bob graduated from Virginia Tech together five years ago. Sally, an engineering graduate, has been successful in technical sales for a major chemical company. Bob, a business graduate, has been an administrative officer for a small company.

Based on their success in working for others, they both wanted to go into business for themselves. They brought a small shoe store in Blacksburg, Virginia, close to their alma mater.

Bob and Sally agreed that Bob would invest 10% more than Sally and thus be the controlling partner in the business.

Sally does the inventory and customer end of the business and Bob does the purchasing and financial end of the business. Sally hired John to carry much of the day-in-day-out customer service. John has a flair for decorating and advertising.

Sally and Bob want to get their management started right. You've been hired as a management consultant to advise them.

Exercise
Pretend that you're Bob. You've dreamed up the idea of carrying a new line of shoes. You call them designer athletic shoes. You've been thinking about the idea for weeks and have considered all the possible alternatives. You're excited about the idea and your strategy for pulling the idea off. You think you know which vendor, which shoes, a neat ad campaign, etc. You have the whole package laid out—who to get, what to say, what to do.

You've just introduced the idea to Sally and John. They like the idea, but Sally says she has a better vendor. John says he has a nifty idea for an ad campaign and which customers would be interested. But, your whole package (system) is being pulled apart at the seams by the people who are where the action is.

You have more experience in the business than they do. You have a complete package set forth in your proposal. They know the vendors and the customers best. After several days of discussion, you don't come around to their

way of thinking and they don't come around to yours. Which way do you go and why?

Fill in the following table. When considering the probabilities the table calls for, include your confidence in what the probability addresses. For example, the probability of a high quality decision should include how confident you are that you as an expert or a lucky person and the group acting as a team will make the highest possible quality decision. Estimate first the probability of a high quality decision for an expert, a lucky person, and the team of you, Sally, and John. Then, estimate the probability of the person who must carry out the decision accepting the decision reached as the right decision. For example, if Sally must deal with the vendors, what's the probability she'll accept as the right decision the decision made by the expert, the lucky person, or by the team, which includes her. Then, estimate the probability of the person who must carry out the decision actually going out and enthusiastically and competently doing what must be done to make the decision a reality. When you have the probabilities for the decision quality, acceptance of the decision, and commitment to carry out the decision, multiply the probabilities together and determine the probability of action that affects the work place due to the decision that's been made.

If action is what's important, who should make the decision? Why? What's the most important thing you've learned from this exercise?

WHO SHOULD MAKE THE DECISION?

Decision Maker	Probability of a High Quality Decision	Probability of Doer Accepting Decision	Probability of Doer Committing to Decision	Probability of Action
Expert				
Lucky Person				
Team Decision				

Quality of decision versus action: Decision isn't important; action is.

Figure 1.6.2.1.13. *Which process for decision making leads to the highest probability of action? (A decision without a corresponding action is of no value.)*