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Communication in the Technical Organization

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ABSTRACT

Virtually all businesses and organizations have communication problems. The aerospace business is no exception and has its share of normal as well as peculiar communication problems. With reasonable attention to communication problems and weaknesses, basic causes can be identified and appropriate solutions provided. This paper addresses itself to communication concerning the technical organization as well as the individual. Analysis is made of the cause of communication problems with both the organization and the individual within the organization. Causes of miscommunication are identified, and corrective as well as preventive remedies are presented.

INTRODUCTION

The expression, "We have a communication problem," is one which has been made frequently in virtually all types of businesses. Such an expression covers a multitude of sins and, frequently, no effort is made to identify the real sin such that a corrective or preventive measure can be taken.

This paper is addressed to a study of communications in a technical organization with emphasis in the aerospace field. The rapid growth of the aerospace industry over the last fifteen years in conjunction with the government/industry teaming concepts has brought about some very complex communication requirements. Certainly, much attention has been given to the complexity of the communication needs and problems in the aerospace field as well as other types of businesses. However, the advances in communication theory and practical applications have not matched the technical advances.

It is my belief that there are practical solutions to the communication problems which exist in the aerospace industry. This paper approaches the problems in a manner similar to the approach that an engineer takes in the development of a piece of hardware or software. Therefore, in a given program or organization, a communication system must be given the same design attention as the hardware.

SECTION I
TECHNICAL INDIVIDUAL

Douglas McGregor has made an observation of management which appears to very accurately fit the communication problems which have existed in the aerospace field over the past fifteen years. Management has been relatively slow to utilize the knowledge developed by the social scientist. "The social scientist's knowledge often appears to him to be theoretical and unrelated to the realities with which he must deal, whereas his own experience-based knowledge is practical and useful."(1)

The technical individual feels that since he is competent in his field, his personal experience coupled with his technical achievements is sufficient to deal with the social science aspects. Therefore, in order to get the technical individual to cooperate in the solution of communication problems, he must be made to understand that there is a problem which needs to be solved.

In any organization or program there is a kickoff point where a plan, or a contract, or a statement of work defines the task to be accomplished. Among other things in a task involving hardware there is a function which accomplishes the hardware design. In addition to the basic hardware design, certain supporting hardware such as test equipment and test tools is required. It is not too difficult for a technical man to recognize the need for supporting hardware and give it the necessary planning and design attention to assure efficient and effective utilization of resources.

Equally as important as any support function is the communication tool or system. In order for the communication tool to play an effective role in any organization or program, it must be designed to fit the particular needs of that organization or program.

The planning function within an organization or program is very closely allied with the communication function. As the aerospace industry grew, the role of the planner was soon recognized as extremely important to individual programs as well as the industry. It is my belief that the majority of advances in communication in the aerospace industry was the result of, or in conjunction with, the advances in planning techniques. The importance of this association is to recognize that some design has gone into communication and that there have been associated benefits.

Many times communication tools are designed and implemented without recognizing that such a design took place. A recent example of this occurred on a launch vehicle program. For a number of launch operations there was much confusion and miscommunication relative to the status of problems which occurred during the launch countdown. There was confusion as to whether or not there was a problem, what was the action taken or planned, and when was the problem resolved. The solution to this problem was the design of a simple communication tool which consisted of a status board of all problems. This enabled all concerned parties to readily determine the existence and status of problems.

The significance of the above example is that a communication problem existed and a remedy was administered by the design of a simple tool. Further, this remedy enabled a significant improvement in the efficiency and effectiveness of the operation. It would be very difficult to assign a quantitative value to the benefit derived from the implementation of this tool. What is known is that the confusion which previously occurred because of the communication problems no longer existed. Unnecessary analyses and investigations were also eliminated because the miscommunication was eliminated.

In conjunction with the observation of the expression, "We have a communication problem," there are other aspects of the technical organization and individual which need to be understood. It is necessary to recognize some things which have taken place in the growth of the aerospace industry over the past fifteen years.

Technical organizations have increased in complexity within corporations as well as within the industry. Software and business management requirements have grown from approximately a 5% proportion to over 50% proportion of total effort. In some parts of the industry, engineers are required to expend 80% of their effort on software functions.

Basically, the engineer or scientist has prepared himself primarily to do a technical job. Engineering colleges have little room in their curriculum for English and business courses which would better prepare the engineer to meet the total requirements of his job today. In a technical sense the recent engineering graduate is well prepared to enter industry and cope with the technical challenges of his job. In a business/management sense he is not prepared.

M. D. Morris did some research on the writing ability of engineers to determine why engineers don't write. He determined that heredity, environment, tradition, education, economics, inertia, fear, and perhaps incomprehension of the need were factors affecting the writing of engineers. In the design of a communication system or tool as well as the solution of a communication problem, these factors are very important. Some people have natural ability and talent to write and to communicate. In others, education is necessary to develop a capability to communicate. It is also frequently necessary to overcome psychological factors. "The engineer, being struck dumb in his lack of professional expression, abandons a principal part of his role as a leader in society when he abandons his communication with the public and with his colleagues."(2)

Perhaps the most important of the above factors is education. Very few engineers are adequately equipped through educational background to meet the communication demands placed on them. One thing which is certainly alarming is that those responsible for college curricula do not recognize the need to teach engineers how to write and communicate sufficiently to put the necessary courses in their programs. Various college deans have said, "We'd like a writing course in our curriculum, but it is so crowded now with required studies that there is room only for three nontechnical elective courses, which must be in the humanities."(3) Some colleges have solved this problem by having an English Department within the College Engineering Department.

Many technical people are victims of the negative Trust and Performance Cycle. Initial attempts at writing and communicating likely met with much criticism which then put the damper on any future attempts to write. Because the engineer has the label attached to him that he can't write, he then does not try to. Likert suggests two general ways to break the negative or destructive cycle. The engineer can respond to the low trust with high performance or the critics of engineers can respond with high trust in the face of low performance. The latter of the two methods is quite unlikely to be successful for two reasons. In addition to high trust, it is necessary that the engineer enters an education program to improve his capability. High trust might eliminate part of the fear of failure, but the increased or improved capability can be accomplished only by some form of training or education. Secondly, the critics are too numerous and widespread to make them aware, much less convince them that high trust would contribute to elimination of the engineers' communication problems.

It is worthwhile, then, to conclude that certain things need to be done on an individual basis for an engineer or technical person to improve on his communication capability.

One of the first things for a person to improve his communication capability is to recognize that he has a need to improve on his communications. One thing which makes it difficult for an engineer to recognize that he has a communication problem is that it is highly distasteful to him to admit that he has a shortcoming. In his field the average engineer is competent and subconsciously translates this competence to other fields such as communication.

An approach to convincing an engineer to educate him to the idea that the role of the engineer today is in reality that of a manager even though he is not directly managing people. The technical role of an engineer is only part of the total role he must play in order to do the total job effectively and efficiently.

A job description of an engineer now, in addition to the technical aspects, includes such activities as contracts, finance, estimating, administrative, etc. These nontechnical activities place far greater communication demands on an engineer in order to do his total job.

A common hindrance in communication among technical people is the behavioral characteristic of defensiveness. One of the main reasons for defensiveness is the inability of a person to acknowledge differences. When differences cannot be recognized, a person becomes defensive and prevents the flow of communication. When a person is encountered with differences, he feels that his world is threatened, and he tends to fight back--the threatener is now threatened, and endless conflict generally follows. Such a situation is not only destructive to the individual from the standpoint of his communication ability, but his growth and progress as well. Obviously, the corrective of defensiveness is for a person to first of all recognize the presence and consequences of defensiveness, then practice overcoming them by tolerating differences and objectively evaluating perceptions which are different from his.[4]

Bypassing is a pattern of miscommunication which is more common in communications between technical and nontechnical people. There are, however, occurrences among technical people which must be recognized. Bypassing occurs when people miss each other's meanings. It occurs when people use the same words to mean different things or different words to mean the same things. The immediate consequence is that there is apparent agreement on meaning when there is actually a disagreement, or an apparent disagreement when actual agreement exists.

One of the basic causes of bypassing is the unconscious assumption that words mean the same to other people as they do to us. A fallacy in this assumption is that words have meaning when actually words have only the meaning that a person attaches to them. Another fallacy is that words have monousage such as the word "fast." In a technical sense, however, many technical words do have monousage or meaning.

Suggested correctives to prevent bypassing are:

1. Be person-minded--not word-minded.
2. Query and paraphrase.
3. Be sensitive to contexts.[5]

Allness is a pattern of miscommunication which in reality is a failure to recognize when we are abstracting. Abstracting is the focusing on some details while neglecting the rest. False assumptions which lead one to be guilty of "allness" are:

1. It is possible to know and say everything about something.

2. What I am saying is all that is important about the subject.

Allness contributes to certain problems in the effective flow of communications. Judging the whole by its parts is common. As in the example of a component made by the XYZ Company which was defective and caused a delay in another company's operation, it is immediately concluded that XYZ Company manufactures defective parts. What has happened then is that the part we dislike becomes the whole until we get to know the whole. Allness is also a contributor to being intolerant of other viewpoints. A person afflicted with allness cannot reconcile differences because in his warped logic his viewpoint is the only right one; thus, others may appear to him as stupidities, hindrances, or even threats.

Allness and viability are inversely proportional to each other. As allness increases, viability decreases and vice versa. Once allness has reached a balance or equal with viability, growth ceases and stagnation begins.[6]

Correctives for allness are to develop a sincere humility that you can never know all that there is to know about something. Keep an open mind such that you don't confuse necessary firmness with preconceived stubbornness or unreasoning prejudice.

Frozen evaluation is a form of miscommunication which is basically the assumption of nonchange. It is the unconscious or even deliberate spreading of an evaluation over the past as well as the future without regard to change. Assumption of nonchange, among other things, limits the progress of technology and business in general. Results cannot only be limiting in nature but destructive as well. Two correctives to overcome the frozen evaluation problem are to accept the premise of change and apply the when index.

SECTION II
ORGANIZATION

Continuing with the premise that if consideration is given to the design of a communication system, the question is raised how then can this design be applied to an organization. In order to design a communication system, the specification for the design must first be developed. In order for an organization to function effectively and efficiently, there must be a communication system which links the organization together.

What then are design considerations for a communication system for a technical organization? First of all, the interdependence of the elements of an organization demands coordination on the part of each for the organization to function effectively. The tool then which effects coordination is communication. Each element or individual in an organization must first recognize that he must contribute or give a little to each other. Among other contributions, that of communication is one of the most important for effective operation of the organization.

The head of an organization designs the organizational superstructure which shows the relationship of one person to another. Once the superstructure is designed and built, the head of the organization must communicate job duties and responsibilities to his next lower level of supervision. In turn, the lower levels of supervision communicate duties and responsibilities down until all in the organization have their job functions defined.

In Section I, attention was given to the development of the technical individual relative to his communication capability. In the design of an organization, generally, the pyramid configuration is recognized as the most effective and efficient.[7] This general design is most frequently used and lends itself to reasonably effective communication. Many of the complexities of communication in recent years have been more a result of the introduction of so many new technical disciplines and appendant technical organizations. It is this type of complexity which deserves the greater attention insofar as design of organizations from a communication standpoint. Figure II-1 shows a typical organization of a small corporation involved with a common commercial product such as a motor, engine, boat, or appliance. In such an organization, the organizational chart in itself serves as a basic guide for the lines of communication and associated responsibilities of the elements of the organization.

Let us now look at the increase in complexity of interfaces and communication lines that a large aerospace program introduces. Reference was previously made to new technical disciplines and appendant engineering organizations. In the last fifteen years or less such disciplines as biomedics, biophysics, biochemistry, and the space mechanics and sciences have not only introduced many new technical terms but have caused a great expansion of engineering organizations. This has extended the lines of communication within the technical organization as well as increased the number of interfaces.

Also, aerospace contracts have introduced such appendant engineering functions as quality engineering, reliability, maintainability, functional analysis, and management engineering. Organizationally, most of these functions are not a part of the line engineering organizations. For this reason, responsibility and authority redundancies have resulted, and communication lines are confounded.

In some of the larger programs, government/industry teams have been set up to perform the various functions necessary to carry out a program. With the introduction of these complexities, little attention has been given to design organizations such that communication efficiency is given due consideration. It is my belief that efficient and effective communication will result only if it is designed as such.

The engineering profession utilizes many working tools in the course of doing its job. One of the most important of these is the tool of communication. It is the least recognized as well as the most abused tool by the members of the engineering profession.

Compared to other tools in the engineering profession, the communication tool is hardly ever designed as others are, or is it exposed to a design review. In most instances, communication is brought into being without the benefit of a design effort on the tool itself. After it is brought into existence, it is rarely ever exposed to any maintenance or calibration because it has not been built to a given specification or design.

It is my belief that if the engineer can be brought to recognize communication as a tool and give it the same planning, design, and review attention as a hardware tool, the effectivity and efficiency of the communication tool can be improved.

The engineering element of Figure II-1 essentially represents the line functions of an engineering organization. These functions include such things as design, drafting, test, and liaison to satisfy the technical needs to produce a product. Now, if we add in the functions of Quality Engineering, Safety Engineering, Reliability, Functional Analysis, and Maintainability as shown on Figure II-2, we can see how the responsibilities and communication lines can become complex and confusing.

Assuming that everyone in the organization as shown in Figure II-2 was educated relative to communicating with others, communication problems would still exist unless some other attention was given relative to the overall organization. Overlapping of responsibilities is one of the biggest contributors to organizational communication problems. A way to minimize this is to tabulate all of the functions of the total organization as shown in Figure II-3 and determine what redundancies of functions exist between elements of the organization. If this tabulation is done on an organization which has been in existence for some time, it is likely a number of redundancies will show up. Ideally, such a tabulation is desirable at the start of an organization or as elements are added to the organization. Once the redundancies of responsibility for functions are identified, an attempt can be made to eliminate these redundancies and thus improve the efficiency of the organization.

Overall technical responsibility for a particular hardware or software design lies with the design engineer or group which did the basic design. This responsibility is not divisible. Introduction of appendant technical organizations has tended to divide the technical responsibility for a particular piece of hardware or system. Division of technical responsibility invites unnecessary technical problems as well as communication difficulties. For purpose of this discussion, attention is addressed to the problem of communication.

Figure II-4 shows the technical communication interfaces without the introduction of any appendant technical organizations. Not shown on this Figure are the communication lines between other elements of the total organization. With the introduction of Appendant Technical Organizations, there is an additional line of communication set up with the design engineer. This additional complexity of communication lines can be seen in Figure II-5. Now, if all of the communication interfaces would be shown for all of the elements of the organization, there would be nothing on Figure II-5 but interface lines.

Figures II-1 through II-5 essentially concern an individual corporation. The aerospace industry has further compounded the lines of communication by the establishment of government/industry teams. Without laying out the complexity of interfaces that a government/industry team composed of a government agency, integrating contractor, and three to eight associate contractors would introduce, it should be apparent from the previous example that the communication interfaces would be extremely complex.

The intent of this paper is not to say that organizations should not be complex in nature. It is, however, an intent to bring out how the introduction of Appendant Technical Organizations and large organizational teams can increase the complexity of communications. It is safe to assume that operating costs are proportional to the complexity of the organization insofar as communications are concerned.

CONCLUSIONS

1. Technical people are not as effective in their communications as they could be because they have not been educated and trained in communicating to the extent that they have been trained and educated technically.

2. Technical organizations are not as effective in their ability to communicate because effective communication has not been designed into the organization.

3. Improvement in organization communication does occur, but as a by-product of some other problems rather than a recognized communication improvement.

4. Communication, effectively, can be improved by educating and training technical people in their ability to communicate. Also, it can be improved by designing organizations with communication effectivity in mind.

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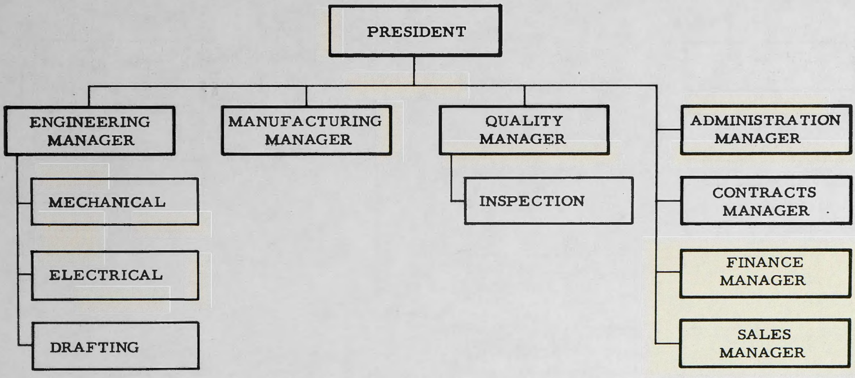
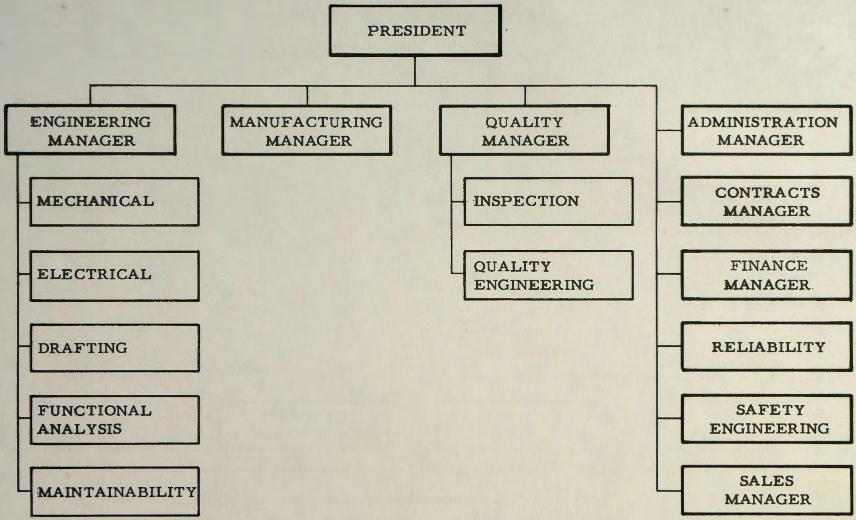
ILLUSTRATIONS



BASIC ORGANIZATION CHART
FIGURE II - 1

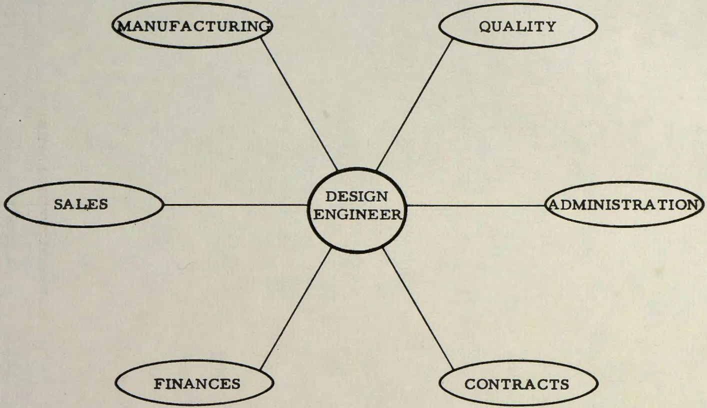


ORGANIZATION CHART WITH APPENDANT TECHNICAL ORGANIZATIONS
FIGURE II - 2

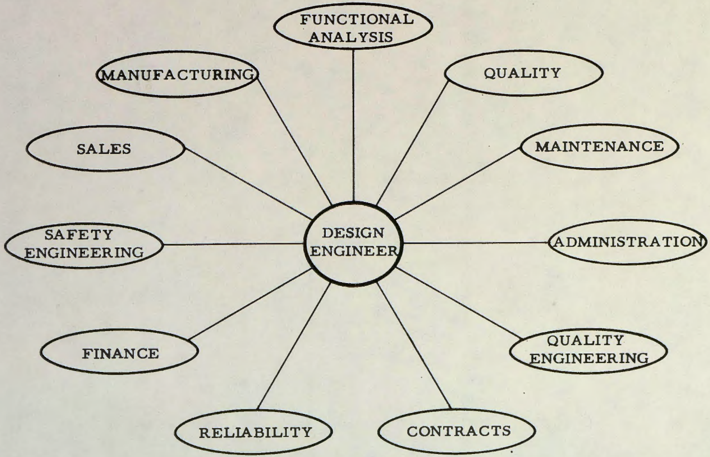
TECHNICAL FUNCTIONS	ORGANIZATIONAL ELEMENTS				
	A	B	C	D	E
1. ADVANCED DESIGN	X				X
2. DETAIL DESIGN	X		X		
3. SPECIFICATIONS	X			X	
4. DESIGN REVIEW	X	X	X	X	X
5. PROPOSALS		X	X	X	
6. SPECIAL STUDIES	X	X	X	X	X
7. CUSTOMER COORDINATION	X			X	X
8. STATEMENT OF WORK		X	X	X	
9. ESTIMATES		X		X	X
10. DOCUMENTATION	X		X		
11. TECHNICAL LIAISON	X		X		X
12. RELIABILITY			X	X	X
13. MAINTAINABILITY		X		X	X
14. DATA HANDLING	X	X		X	
15. DATA ANALYSIS	X		X		X
16. SUBCONTRACTOR LIAISON	X	X			
17. TEST PROCEDURES	X		X		
18. SAFETY ENGINEERING	X			X	
19. PROBLEM RESOLUTION	X		X		X

RESPONSIBILITY TABULATION

FIGURE II-3



ORGANIZATIONAL INTERFACES
FIGURE II - 4



ORGANIZATIONAL INTERFACES WITH APPENDANT TECHNICAL ORGANIZATION
FIGURE II - 5