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Liaison relations in industrial research

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Liaison Relations in Industrial Research

by

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This thesis was prepared under my supervision and approval is hereby indicated.

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Introduction

This study was undertaken to present an analysis and recommendations on the problem of providing more effective liaison relations in industrial research. Corporate research and development in technological fields necessarily involves the handling and channeling of information and instructions between the laboratory and other groups within and outside the company. To apply effectively the results of its research activities the firm must have a high level of efficient communications among and between all of its divisions and departments. The dissemination of research results should be carried on at an early date between the laboratory and the sales, engineering, production, finance, and general administrative functions.

Liaison relations in industrial research encompass both the staff function performed by a formal research liaison group as well as the multitude of less formal day-to-day exchanges being carried on by individuals in the performance of a common task or goal. On the one hand, a liaison group can be made directly accountable for the flow and effective communication of research information between the laboratory and the using departments.

Their services as intermediary links in the complex communication network of a corporation ensures a more concerted research and development program. The scope of such a group's responsibilities will be explored in this study. In addition to such assigned channels of communication and command there occur many less formal but just as necessary private contacts between individuals. Also, and it will be one purpose of this study to explore them, there are many instances where some liaison was never effected though vital to the company. It should be the duty of the formal liaison team to seek out those company persons in need of specific information and to establish company-wide relations and contacts to ensure its transfer. They may either pass along data second-hand between the source and the user or, by introduction, provide direct communications between the individuals concerned.

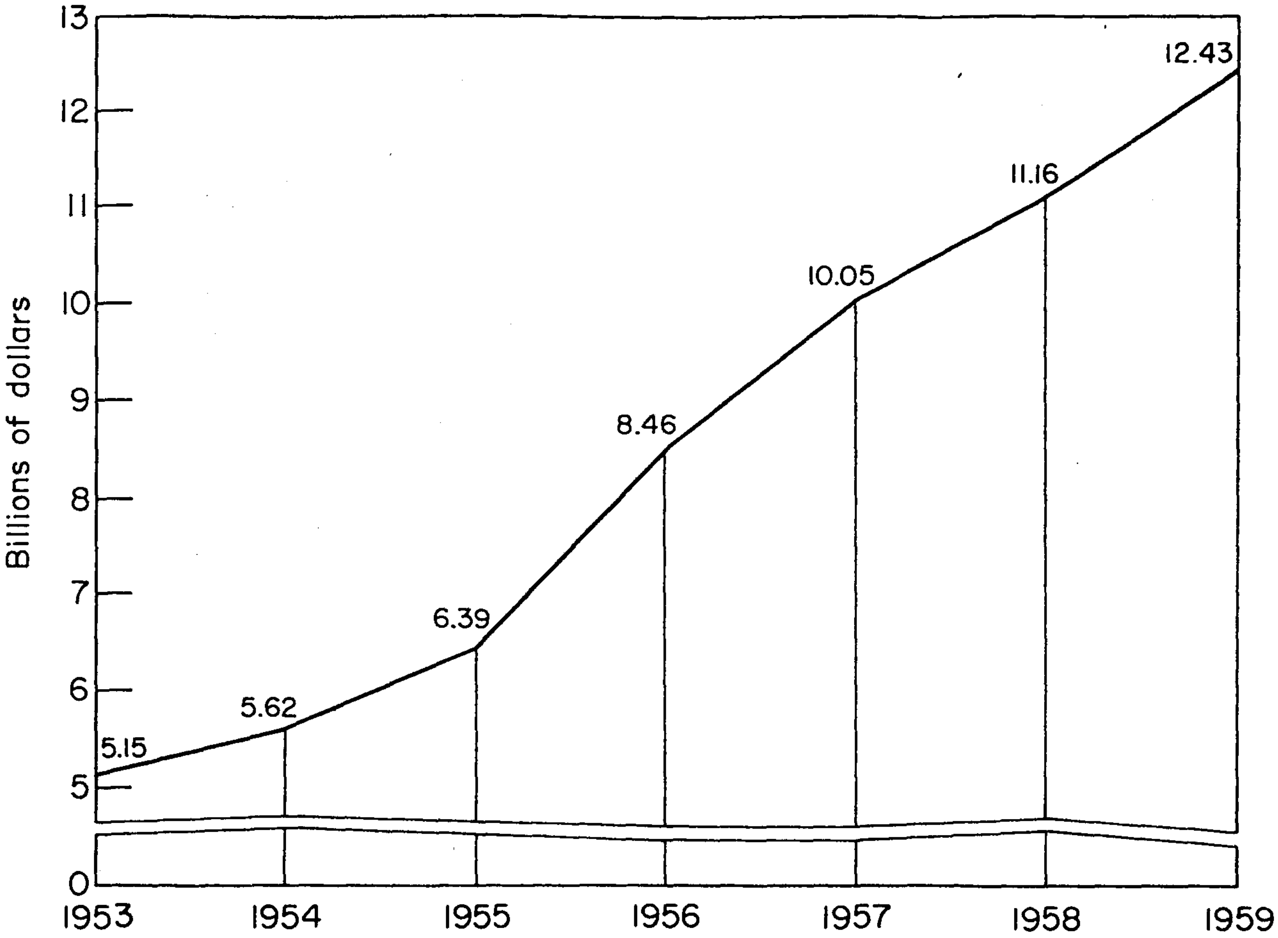
These liaison relations will be discussed by analyzing several important aspects of the problem. These factors will make up the main body of this study. Taken in order will be the objectives of industrial research, types of information flowing to and from the laboratory, the generators and users of this information, some obstacles to the free exchange of information, and the purposes served by research liaison groups. Before conclusions are made a case study will be presented to illustrate and validate the factors given earlier as being pertinent in a discussion of liaison relations in industrial research. The name of this case study company has been disguised. The case study information was obtained in three ways: 1. Through the author's association with the Research Division of this firm from 1956 to the present, this work having provided many opportunities to discuss with others the many existing research liaison problems. 2. Where information regarding research liaison was sought, questionnaires were sent to several of the laboratory supervisors and, whenever possible, a personal directed interview was arranged. 3. Information was solicited from the scientific staff itself and their technicians. This was accomplished, for the most part, by questionnaires alone.

Importance of Industrial Research

Data now available from the National Science Foundation's continuing program on surveys on research and development (1) indicate that during the period from 1953-59 the nation's total funds expended for industrial research and development have increased from slightly over $5 billion to over $12 billion per year. As Chart I indicates, this is a rise in research expenditures of 140% in just six years. The rate of growth of these expenditures in recent years has been about 11% per year.

Research has now become a major expense in both government and industry with large research and development centers being quite common today (2-12). Scientific and engineering work conducted by industry fosters the technological and product advances necessary to keep abreast with the ever-increasing demand for new and improved products. Only by improving administrative techniques and practices in planning and controlling these research activities can industry succeed in its mission. Our constantly rising level of living and expanding defense requirements make the problem of improving our industrial research capability one of national significance.

The research function is also vital to a company's operation as the success of the firm itself is tied directly to the development of new and improved products being born within its laboratory (13-15). Companies in the electronics field, for example, rely on selling new products today that were entirely unknown a few years ago. Similarly, many of these firm' s future products are probably unknown now. Competition requires an active and productive research program to be maintained by every firm with the exact type and degree of specialization being determined by the company's own characteristics and background. Concurrently with the intensification of competition in the market, research and development has become a major responsibility of management. A company' s ultimate success depends on its ability to keep abreast of the competition, to grow with the industry, and to constantly provide more and better products through diversification or improvement in quality with a lowering of product cost.



Source: National Science Foundation, December 1959

CHART I. EXPENDITURES FOR RESEARCH AND DEVELOPMENT, U.S., 1953 - 1959

The Liaison Function (16-18)

Good communications are important in all of industry but because future growth and security in the market is based on productive research and development, it has become indispensible in the specific area of industrial research. The jobs and departments within most industrial companies have usually been broken up, divided and sub-divided by functions to the point where even the minimal amount of planning and coordination of activities requires a high degree of information and directive interchange. The liaison function ties the many cooperating groups together to ensure concerted action. For small firms this function can be less formal and on a personal basis. For large companies, however, a formal liaison program is desirable.

When certain obstacles or hostilities exist between two groups in a company that should communicate with each other, rendering full cooperation impossible, a third group or liaison team can overcome these barriers and will facilitate the transfer of all necessary information flowing both ways. Acting as an intermediary link, such a group staffed by technical specialists would touch all phases of corporate activity and by means of its contacts throughout the firm it would establish additional channels for communication of coordinating data. Management's task of organizing and utilizing information for decision making would thus be made easier.

In regard to industrial research alone, liaison relations enable a smoother and earlier transition of research data from the laboratory to the development and production stages. Later, through further liaison, the product is brought to the sales function and hence to market at an earlier date than what might have been with a poor flow of information about the prospective product. When a new product is invented and perfected in the laboratory a disclosure is made to the production and sales departments. If the marketing possibilities are favorable and manufacturing seems feasible the decision is made to place the new item in production. With the ever-pressing threat of competition facing management, it is very advantageous to get each new product on the market at the earliest possible date. The liaison function can speed up the process of product transition from research through production to sales by furnishing to the latter functions advance information and other specifications vital to production control and sales forecasting.

Planned organization and corporate coordination which enables progress to take place would be impossible without communication. The more highly developed the methods of communication within an industrial firm the more p rogressive and advanced that company' s operation is likely to be. Research is a group enterprise in most industries (19-23). A cooperative effort allows individuals to apply a maximum of their specialized knowledge and abilities to those problems most important to the company.

Each scientist's contribution to a firm's research program, when united, can effect gains which are greater in the composite than the total of individual contributions when disassociated. Communication and the liaison function attempt to coordinate research activity in order to derive the maximum effectiveness from it. The organization of a staff group to perform these liaison relations will aid management in these important objectives.

A company experiencing poor communication among

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A company experiencing poor communication among its various departments may have serious delays, waste, and possibly duplication in its research and development program. Constant follow-up and checking will have to be performed to expedite each separate project. Without full company-wide cognizance of the current progress being made in the laboratory, the results of research will be less effective. It is often the case that a moderate delay in applying these results will result in their becoming stale, having lost their novelty or competitive advantage as marketable commodities. A sluggish research program can only mean increased product costs over that of the ideal situation. With liaison relations established throughout a company the results coming from its laboratory can be more quickly applied to new products. There will be a reduction of development costs per product and a closer and earlier R&D budget can be formulated. The over-all plan of transferring new products from the research function to sales will be more easily defined and analyzed. A much higher degree of over-all research effectiveness can thus be accomplished.

Definitions

This study will be concerned with the flow and use of information in industrial research with the aid of liaison relations performed as a separate function by a staff group as well as the regular day-to-day line activities in communicating. The meaning of liaison and the liaison function in industry should be defined and explained before a detailed discussion of the subject is attempted. The following explanations are now offered. The dictionary (24) definition of liaison states:

> The contact maintained between groups to ensure concerted action.

The author now offers an expansion of this definition as it applies to liaison relations in industrial research:

> The task of coordinating research and development activities and the associated communication involved in accordance with corporate plans so that preconceived objectives and results can be attained or surpassed with optimum economy and efficiency.

As a simple example, suppose that there are two groups that must cooperate with each other in a company. Because of a lack of established relations, or a host of other causes, coordination and planning is made difficult. Progress towards more efficient information exchange and action is slow. The reasons for this will be taken up later. A liaison group or team can stimulate better relations between these two sides and can carry on the communication function between them until spontaneous cooperation has been effected. At that time, the goals and objectives of each of the groups can be accomplished with maximum efficiency and speed on their own. These relationships will be discussed in detail later. An analysis will be made of the planning and methods taken by management in establishing company-wide coordination of its research program using the medium of liaison groups.

Work Previously Done by Others

In the opinion of the author, the most thorough and up-to-date references currently available that deal directly with industrial research, communications, or liaison relations for research are compilations of papers read at a series of conferences on industrial research held at Columbia University in recent years (25-27). A series of industrial liaison workshops have also been held during the past few years at the School of Industrial Management of M. I. T.* A complete list of references can be found in the Bibliography at the end of this study.

*The reports of these conferences are available in the Dewey Library, M. I. T.

Method of Approach

The following discussion and analysis of liaison relations in industrial research will be oriented towards those aspects and problems associated with the management function. It is on management and their subordinate supervisory personnel that the ultimate responsibility for an effective research program lies. It is their job to establish a research liaison group and to see that it is properly staffed.

After the general discussion a case study is presented to illustrate the points made earlier. The company chosen* is ideal in that its research program is an essential factor in maintaining its position as one of the leaders in the electronics field. A detailed description of their research liaison activity is given. Information about this company was obtained from work experience, directed interviews with laboratory supervisors, and a group of questionnaires sent to the scientific staff and their technicians. This research has been outlined in the Appendix following this report.

* The name of the firm has been disguised.

II. Factors Relating to the Liaison Problem

Mission of Research Groups (28-48)

Industrial research covers a wide range of interests and responsibilities encompassing the fields of activity of all the manufacturing divisions of a company as well as unassigned fields of potential future interest. These activities should have a broad scope and be limited only in regard to the type of work rather than to the exact technical area of study. In performing these functions it is necessary for the research group to receive, generate, and apply information to the problems at hand. Any prior knowledge of a subject and any new data sought to accomplish work in that area would be classified as information received. Empirical experimental observations, formulas or generalities derived, and recommendations made would be considered generated information. Using research results to further develop company products or to enhance the firm's over-all capabilities would be an application of research information. These considerations are important in determining the range of useful liaison activities.

The general objectives of a company's research activity must always be to assure an upward long-range trend in earnings and a steady advancement of its relative position in the industry through extension and improvement of its product line and strengthening its research capabilities. Listed according to the magnitude of annual expenditures are four general classifications for corporate research in the electronics industry.* The competency of the scientific staff, as well as the liaison group involved, will have to lie within these areas:

1. Development and entrepreneurial activity to provide new and improved products as well as to launch new enterprises growing out of research.
2. Scientific consultation and assistance to management and the manufacturing divisions.
3. Study and research designed to keep the company abreast of scientific progress in broad fields of company interest.
4. Exploratory and basic research in selected areas which hold promise for the development of products within the scope of the company's potential interests.

<u>Types of Information (49-51)</u>

The information flowing into the research activity, the information generated there, and the use of information to apply research results can be subdivided further. Chart II depicts the several classifications of information of

*Suggested by the Vice President and Manager, Research Division, ABC Electric Company (The name of the company has been disguised.)

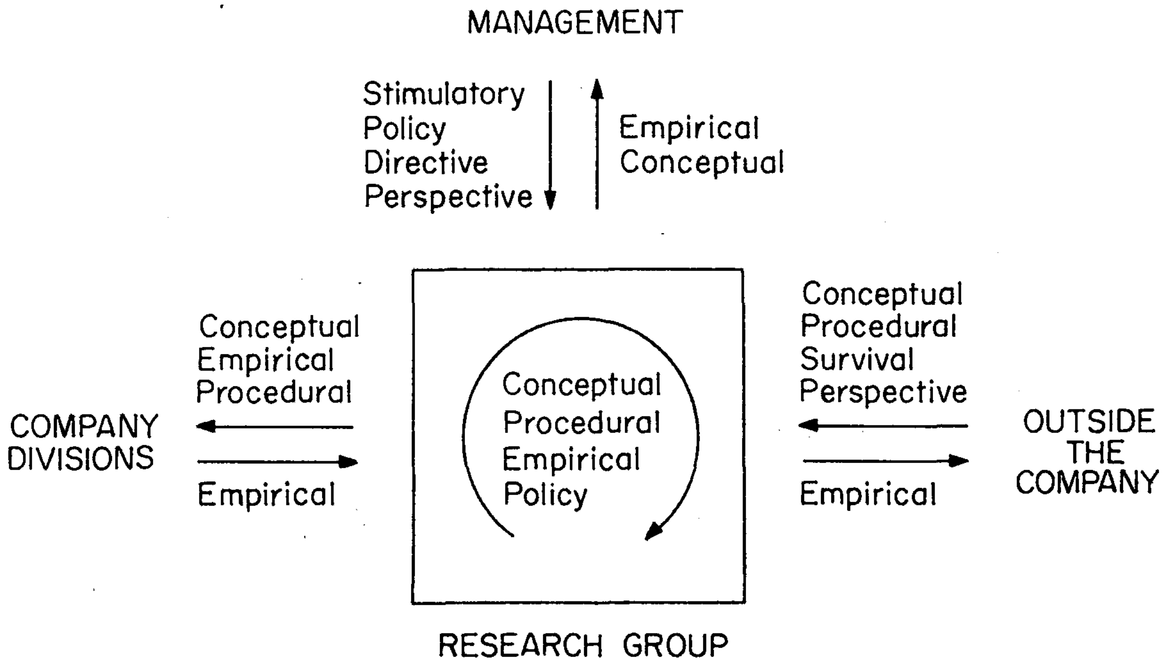

CHART II. TYPES AND SOURCES OF INFORMATION REACHING THE RESEARCH LABORATORY specific interest in a discussion of liaison relations in research.

The types of information flowing into the research group are shown next to arrows pointed inward. Data and experimental results flowing away from this activity are placed next to arrows pointed outward. Information exchanged within and among the researchers is shown by the circular arrow inside the research group box.

Conceptual information is basic theoretical knowledge that is required to apply the scientific method to research problems under investigation. Conceptual knowledge can be obtained from prior academic training, previous work experience, or from other specialists. A researcher might ask his supervisor or some other scientist a question on some theoretical point. This would be one method of acquiring conceptual knowledge. To better understand its research program, management often requests an explanation from the laboratory on some particular phase of its work. If this discussion involves a basic concept of science, it would be a transfer of conceptual information.

Empirical data are usually generated from experiments performed within the research laboratory. This information should be quickly and accurately distributed to all interested groups within the company as this type of reporting is the basis for planning and utilizing research results. Empirical data are the medium by which laboratory projects are transferred to engineering and later to the production stage. Empirical data derived from some production problem are often given to the research group. They are asked to use their broader training and background to provide an adequate solution.

Procedural information is necessary to keep the research and production functions up-to-date by bringing to light the very latest in equipment, procedures, and techniques. One of the most important services the research group performs for the operating divisions of a company is the generation of this type of information.

Both survival and perspective information are necessary ingredients in the background of every scientist and technician. Survival information is that knowledge gained from everyday experience and reading that makes a person well-rounded and imaginative. Perspective information provides the researcher with a balanced judgment in choosing the areas for research that will provide the best long-range benefit to his company. It develops his intuition and judgment in areas outside his immediate specialty as well.

Stimulatory information is usually supplied by management. It can take the form of informing the scientists about the other activities within the company, company goals and ethics, and a brief orientation of management's problems in the research program. A series of seminars covering the duties and operations of the company's many divisions or departments will promote a keener interest and a closer loyalty towards the firm.

Directive information takes the form of orders transmitted down the line organization for the performance of specific duties. Policy information, on the other hand, is periodically provided by management to resolve the many and diverse interests possessed by its research staff into specific fields of prime interest to the company. It periodically reminds the laboratory group of its main objectives and gets the progress of research back in the right direction.

<u>Sources of Information (52-56)</u>

Members of the research laboratory rely on many different sources for their information. Each scientist has had some degree of formal training in his or her specialty. This may have started with a major course of study in college. It includes any work instruction that they may have had such as orientation sessions, tours, or training programs.

Once a particular project has been started by the scientist he makes a search of all previously published material on the subject. This search of documents and interviews with experts in the field constitutes an important source of new information during the initial phase of a scientific study. Sometimes information comes from unsolicited sources. One member of the research team may know of another' s interest and will route an article or clipping to him. The supervisor and fellow colleagues are potential sources of new information.

Experimentation produces a regular supply of new and fresh information vital to the progress of any research project. Often decisions as to what types of experimentation should be performed will depend on the results of past work. Sometimes a new interpretation of old information will lead to a change in research plans. Because basic research is constantly at the forefront of scientific knowledge, guess and intuition are major factors in further progress because decisions cannot always be based on specific and proven facts.

Communication of Information (57-60)

The manner in which information is generated or directed sometimes influences the way in which it is transmitted. Informal day-to-day communication can take the form of direct oral conversations among workers. More formal are the orientation lecture, seminar, conference, or committee meeting. For widespread and rapid dissemination of important company information and directives, the public address system can be utilized. Another type of mechanical communication is the telephone.

Indirect communication can take the form of documents such as memorandums, bulletin board notices, scientist's papers, and the like. Technical records are kept in notebooks. Most research information of lasting interest to the company will be filed in an engineering or research library set up by management. A competent librarian will constantly be on the look-out for new articles and publications of interest to the members of the laboratory. Only by keeping records of previous work accomplished can research progress most efficiently. Without a source of records of what has gone on before at the laboratory a new group may duplicate effort already finished by someone else earlier. Information about one project may greatly aid a scientist on another, and so on. Records, and an accurate catalog of what has been filed, can save the scientist a lot of time in his search of the literature.

Liaison, on the other hand, is a method to facilitate the exchange of more current information. It enables the users of certain information to receive it as early and as accurately as possible. The originators of this data are relieved of the burden of detailed preparation and interpretation of results into the special form most useful to those receiving it. For example, a sales engineer is not very interested in the formulas and technical aspects of a new invention. He is primarily interested in its performance with regard to customer's specifications, its cost, and availability. A liaison group serving as a technical "go-between" could extract from the scientist's report only those bits of information useful to the sales engineer. During the development of a new product, advance information about costs, materials required, and special techniques necessary for its manufacture can be obtained by the liaison group for those requiring this information. The scientist will have a minimum of interruptions due to inquiries from the using parties. Adapting the technical report to each special user is an interpretive function that a liaison group would perform.

Because the majority of communication done within a company is indirect, a liaison team would serve a useful purpose by establishing for each group company-wide connections and relations for planning and coordinating. This liaison group would also be able personally to adjust conflicting situations as they arise. Without liaison, misunderstandings could linger for a long time, compounding hostilities with a consequent deterioration of cooperation. An early resolution of even small problems is essential to company growth and progress.

III. Analysis of Liaison Relations

Communication Necessary for Progress (61-65)

Many different reasons have already been cited for communication programs in industry. The better the liaison between cooperating groups, the more efficient is their effort and the sooner will their objectives be met. Productivity depends on good liaison just as much as on machines, methods, men, or a plant's capacity. Communication between and among the groups of a company is a cumulative teaching process. With time, the background of experience widens as the firm's capabilities increase. Just as teaching and communicating with each other is a prerequisite for the advancement of any culture, so is communication and instruction necessary to any company's growth.

The solution of new problems and the extension of the state of the electronics art relies on a continuing exchange of experiences. Team effort, whether within one company or in the industry as a whole, is the only way to foster new advances at rates necessary to keep up with consumer and defense requirements. Liaison relations open up a new and fresh channel for information flow that has many advantages over a reliance on individual initiative to communicate. It would be the business of a liaison team to communicate. They would have few other responsibilities to divert their attention. A measure of their efficiency would be how well they performed this single function.

Underlying Environmental Conditions (66-68)

To what advantage liaison relations will benefit the research program depends on each laboratory's characteristics and environmental conditions. Does the group possess a stimulating, scientific environment, isolated from the pressures of rigid work schedules; unique library and laboratory facilities; a well-trained and scientifically oriented staff; a flexibility permitting the assignment of personnel and facilities for special tasks; an objective and impartial attitude towards all divisions or departments of the company; and a willingness to serve the best interests of the company?

The laboratory setting is in itself one indication of the effectiveness of the research group. The age of the building and its general condition are important determinants of the laboratory's effectiveness. The amount of floor space and the number and size of offices provided for the staff can influence each worker in his attitude towards research and in his willingness to cooperate in a group effort.

The management of research should carefully evaluate each possible choice of research project and then choose those that can be supported without interruption. Changeability on the part of management can create continuous turmoil in the plans and schedules of the laboratory. Once a project has been chosen, and its potential seems high, it should receive continuous backing until completion. Disruptions in mid-stream can only lower the effectiveness of both the scientific effort and the liaison

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<u>The Communication Net (69-77)</u>

The research laboratory is constantly engaged in many attempts to carry on effective communication and liaison with other groups within and outside the company. The number and duration of such contacts will depend on many factors, such as the type of research being discussed, the area of interest, and the intended duration of the project. The intensity and direction of communication will vary also with time. Establishing early and effective ties between cooperating groups is a major task in companies constantly changing and improving products because of the rapid advance of the industry. Liaison relations can be established to overcome the many potential barriers to effective communication between company groups..

The communication net shown as Chart III* provides a mechanism for information exchange throughout the company. To the research laboratory the channels of authority are different from the usual channels of information flow. Liaison relations are conducted both between groups within the laboratory and with groups outside, either in company divisions or outside the firm entirely. The purpose and effectiveness of liaison relations will vary according to what group is being contacted. It is important, therefore, to discuss the several communication links associated with the research function in order to understand the liaison relations involved. Chart III is a schematic of these relationships. Interdepartmentally and divisionally, liaison relations exist between the research group and the sales, production, and finance functions. Some liaison also is conducted with general management, the law department, engineering, production control, public relations, and with special management

*Breakdown of corporate functions suggested by Harris (72).

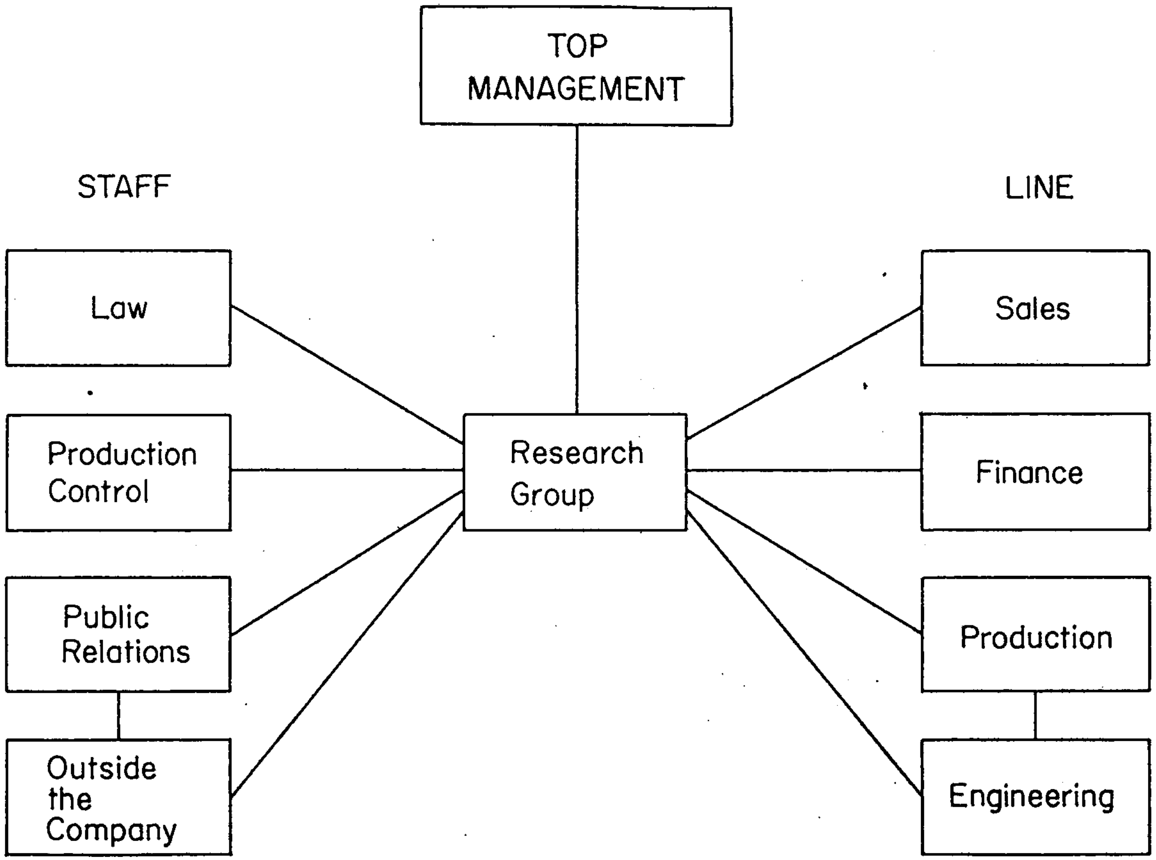

CHART III. THE COMMUNICATIONS NET IN INDUSTRIAL RESEARCH committees established from time-to-time for specific purposes. Contacts outside the firm include those made with customers, consultants, other scientists at professional conferences, and technical people attending industrial workshop seminars.

Good liaison with the sales function can help create in the scientists an understanding of marketing and competition. Although the management usually specifies the general fields of company interest, the sales function can often bring to light specific products that the customer would like. The desirability of certain products can best be judged by the sales personnel in many cases. The sales function must call upon the researchers for technical aid and assistance when negotiating with some customers, especially the military, because of the exacting nature of the contract and its provisions listing performance, size, weight, and the like, in very technical terms. Because military contracts, and others, in the electronics industry are usually negotiated, rather than bid, the advice and assistance of the research staff is desirable.

Besides product choice, the sales function possesses the experience and intuition to judge consumer reaction to new product proposals. The earlier a prediction can be made on the success or failure of a proposed item the more benefit can be derived by management. Design and style trends can often be detected by the sales department early enough

to save a project from total rejection in the market.
The company's capabilities and achievements should be made clear to the sales personnel in order that they may use that knowledge as one more sales point in approaching the customer. Making these two bits of information about the company known to prospective customers may mean the difference between getting a contract or being refused it. The liaison group should keep the sales staff informed of all past and present

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The engineering department is primarily interested in technical information and the results of current experimentation. The laboratory can offer a wide experience of skills and practical knowledge in the design and choice of components being made in the engineering stage. In return, the research team is given a list of standards to go by in its thinking and planning of a new item. The research function should not develop a product that can not economically be made using existing skills and equipment or facilities easily secured through a training program or by purchase.

Production and production control can benefit from early knowledge of a future product by having the extra time available for more accurate planning and scheduling. Instead of keeping the wraps completely on a new item being developed in the research laboratory, some disclosure as to what machines, materials, and other resources will be required for its manufacture is advance information of vital importance to the latter functions if cost and predetermined schedules are to be maintained as planned.

In the fields where product obsolescence is rapid, a lead time which is too long can be very detrimental. The period from conception of an idea to the sales of the product must be made as short as possible. The earlier advance information can be sent ahead, the smoother and quicker will be that product's transition from research to the development stage and then on to production. This relationship is shown as Chart IV. Without some advance liaison between research and the development stage, no advance planning can be conducted until the results of research have been formally compiled and reported to management. Then, if the decision is made to develop further the product, all the plans and specifications are released to the developing group . With advance liaison this pre-planning on the part of the developing function can shorten the over-all time in transit of the product between these stages. Without a formal decision by management before the latter departments perform advance work and make commitments, as in the previous case, it is a gamble if the project will be continued or dropped before its completion. If the development and production departments have been provided with advance information and have arranged for an early transition of the product, an over-all lead time of several months shorter can be accomplished over that with no advance liaison. This is shown as the difference between times T_2 (without liaison) and T_1 (with liaison.) The benefits of an early marketing date and shorter lead time greatly out-weigh the risks of scrapping preliminary plans and investment if the project is terminated. An intense liaison program can greatly reduce the gamble involved with pre-planning on limited knowledge. On some defense contracts where time is of the essence an efficient liaison relationship with both engineering and production is required if the very earliest possible transition is to take place. Such crash programs have such an overlap in the three stages of research, development, and production that the lead time is often reduced to that normally taken by any one of these functions alone.

The production personnel can aid the research staff in many ways. Their judgment as to the suitability of a product choice can often save time and expense at a later date. The laboratory should not invest too much effort in developing an item that cannot be sold or manufactured by the company using existing resources. Machine shop facilities are often useful during the experimental and prototype stages of product development. Production can lend the services of special tools and workers to aid the laboratory in its projects. In return, the research staff

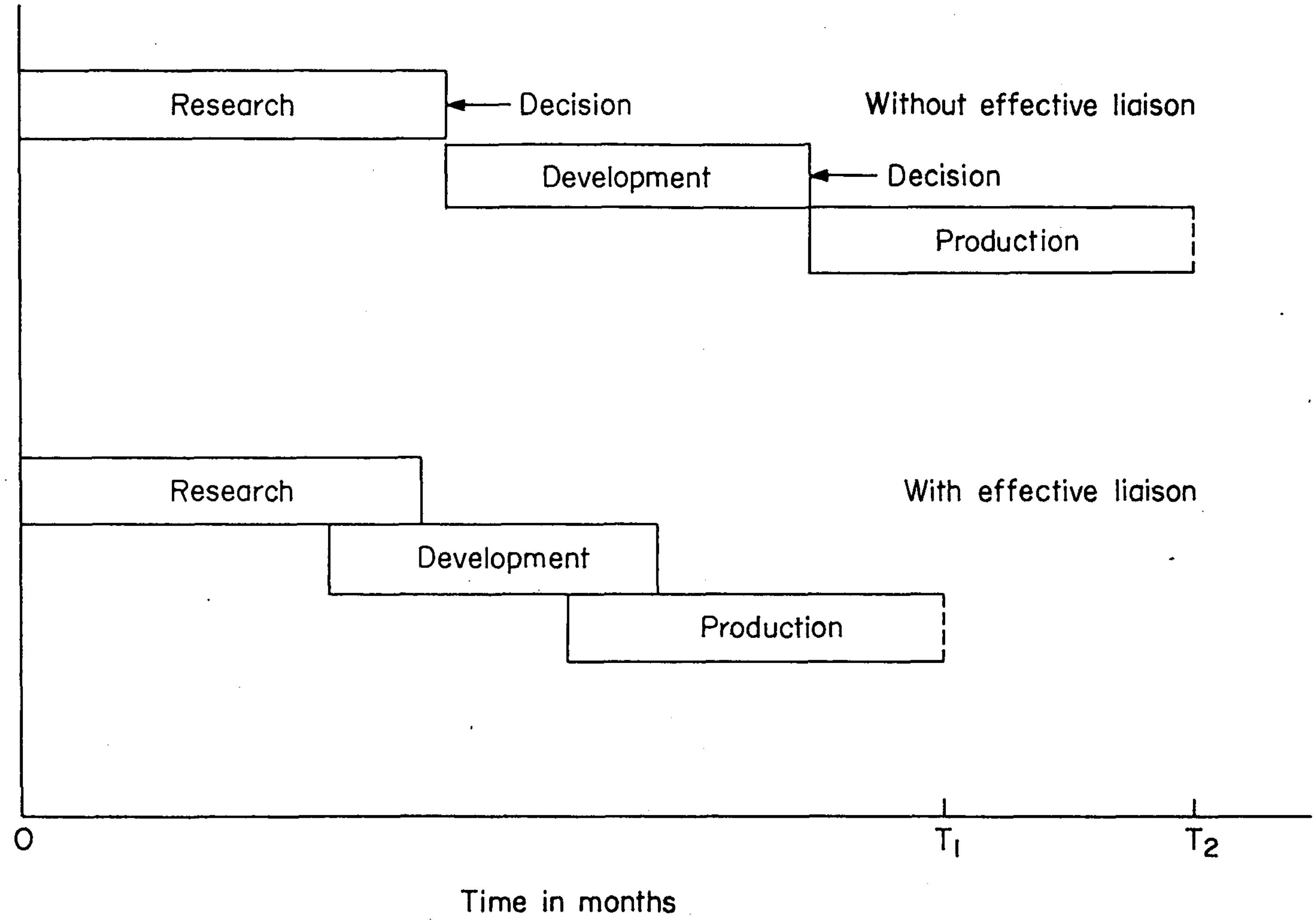


CHART IV. TRANSITION OF PRODUCT FROM RESEARCH THROUGH DEVELOPMENT TO PRODUCTION is often called upon for the solution of subsequent manufacturing problems. The daily contact maintained between these groups can be kept open and of benefit to both sides with a liaison team's help as a "go-between."

Production control activities for research originate within the laboratory, rather than by a planning staff or committee in the case of job order control in intermittent manufacturing. From the research laboratory come the engineering data, design, and technical specifications to be used later by the production control group. Planning for production is performed by a committee made up of the scientists and engineers associated with the development of a new invention, the foreman or manager of the manufacturing department to be involved, and the production control staff. An initial feasibility study is made to determine the appropriateness of the new product in regard to its marketability and ease of manufacture. Instead of scheduling backward from a fixed delivery date this committee plans a program of effort assuring the shortest possible delay before finished goods can be shipped.

The work of this committee adapts the design of the new invention to existing or attainable production techniques or facilities possessed by the firm. The scientist's engineering model of the new invention is converted to standard dimensions, screw sizes, finished, and machine operations. The production foreman knows best the capabilities and limitations of his own department. Either the scientist or a liaison representative must work closely with the foreman to make sure that the product retains its functional specifications. The design of tools can also be jointly determined and work begun on their fabrication. The production control team can assist the foreman in scheduling production by means of their previous experience with similar operations and the time requirements for them. The production program, routing plans, material lists and requisitions, feasibility studies, and initial assembly are supervised by this joint committee. Because of the usual length of time involved and the necessity of cooperating with other people, the researcher often prefers to have a liaison member conduct his part of this work for him. The scientist can then return to his prime interest of working in the laboratory once again. After full production has been achieved the committee is then dissolved and the research liaison personnel can move to new duties. The scientists or liaison team are occasionally temporarily recalled for the solution of unique production problems that come up requiring their special training and experience. It should be primarily the assignment of the research liaison group to perform this additional work as it arises.

The details of production are refined by the production control group and the manufacturing foreman. By recording each step in the process and other related activities as they develop, new production can again be scheduled and commenced at some later date entirely under the direction of the production control group. Usually a satisfactory production operation can be achieved from these records but the liaison group can always lend their assistance and advice on any possible technical problems that do happen to come up.

The finance department of management must carefully measure the profitability of each project carried on in the research laboratory. To do this accurately requires a high-degree of liaison between these two functions. Because the research group has no direct income from sales, it is dependent on continued funding from a corporate budget. In order to guide this financing as closely and as accurately as possible, members from both the research and finance functions should prepare the budget as a mutual project. The liaison group could ideally serve as counsel to the laboratory manager in this situation. Equipment and other laboratory costs for the projects under study can be planned at these meetings.

The research program's relationship with management will depend on how research-minded the administration is. Their orientation towards research and development will dominantly influence the degree of support given. When the company's management possesses a keen sense of responsibility to maintain a top-flight research laboratory they will be interested in any suggestions to broaden and expand the capabilities of this facility. A disinterested management will only review their research program from time-to-time for budgeting purposes. They might occasionally prepare a directive suggesting the fields of study to be emphasized at the moment.

With close cooperation, management can derive many advantages from its research program in addition to its main function of providing new and improved products for manufacturing. Important assistance can be given management in the areas of production techniques, company-wide standardization, procurement, and the preparation of patent applications and other technical disclosures or proposals. The strength and position of a company in the market today often depends on its patent and proprietary information protection. The law department works closely with either the scientists or research liaison representatives in the preparation of new invention disclosures and patent applications.

Although most information flow does not correspond with that of the chain of command or line organization in industrial research, management directives and orders do have to follow this path. Responsibilities are assigned even in a research situation and important communication is done within this framework. Committee decisions are enforced and corporate plans are made known and formalized through the line organization. Company ethics and tactics are manifested through this system. Although a research liaison team should have little line authority, since it is primarily a staff function, its opinions and recommendations can be strengthened through their enforcement by management.

As mentioned earlier in regard to the liaison group's relationship with the sales function, the research program and staff will have many occasions for making contacts outside the company. Technical liaison work is conducted with outside consultants, other industrial and research centers, at professional conferences, customers, and the general public. A special group assigned to assist in these contacts would "cover the field" better and remove some of the burden for making these contacts from the individual scientists.

In addition to collecting information from the various company departments and passing it along to interested parties the liaison group might also prepare "popularized" technical reports covering the activities of the research laboratory. These would be distributed to the general public and prospective customers and sponsors of research work. Stockholders and potential investors are always interested in receiving literature about their company, even if a little technical for them. The preparation of pamphlets and the like would be done jointly with the public relations department or office.

Barriers to Effective Communication (78-83)

Management may recognize their importance but still may not enjoy adequate communications. There may be several reasons for this. A communication program in an industrial company just doesn't happen; it must be planned. Management may have tried to establish liaison relations by fits and starts but not succeeded for one reason or other. A time should be set for the establishment of liaison relations and the responsibilities assigned for their establishment. There are barriers and hazards to communication in industry and a formal liaison plan can help to overcome most of these. In our discussion it will help to look at some of these barriers and analyze them with regard to their effect on the research program.

The first barrier to effective communication is the lack of any liaison or other relations at all between groups, departments, or individuals that would like to communicate. To overcome this situation the need of that group seeking information should be made known to the one possessing it. Channels of introduction to both staff members and their fields of interest will give to each group a knowledge of the other's activities. Although action across channels or in separate divisions of a company is sometimes hard, information flow is usually easily established. All that is required is a knowledge of the other group's need. Since the chains of command are quite dissimilar in a research department and a manufacturing division, one individual may not know whom to contact. There exists no exact "opposite" to him. A liaison group overcomes this barrier by virtue of its "staff" nature and company-wide relations.

The various departments and divisions communicating with the research laboratory may have very much different organizational objectives. For instance, a plant manager may be more interested in manufacturing established products than brand new ones. The transition of a new item from the research function to production is thus made more difficult. This task is made easier when a liaison group can act as "go-between" and tactfully but relentlessly smooth the way for the new product. On the other hand, conflicts frequently come up when the production phase is eagerly waiting for a new product to emerge from the research function. The disagreement most likely to arise here is in the area of the degree of perfection of the product. The manufacturer hopes for a very early transition in this case while the researcher is a little reluctant to admit its readiness. A liaison team can aid in this decision by using their own judgement gained from company-wide associations. Too often, the time taken to "over engineer" a new product just loses for the company any time advantage it might have had in the market. The liaison group is likely to know of this condition and can make it known to both parties.

There may be differences in organizational objectives acting as barriers to effective communication. At the supervisory level may be the opinion that a personal contact on the part of a researcher or a technician is a neglect of his regular duties. At the group or department level may exist several reasons or manifestations of an anti-harmony complex. There have been some previous unpleasant experience between two groups that now should cooperate on some new project. Personalities may also be involved. A liaison group acting as an intermediary will either resolve or serve as a buffer between these differences. Sometimes, but not directly motivated by action in the best interests of the company, a department will hesitate to cooperate with another because of pride. A successful division will not be eager to spend too much time, at its own expense, assisting a rival manager with his division's problems. A staff committee or liaison group would bridge this difficulty. A manufacturing division may prefer its own products. New items coming from some remote research activity may not be greeted very warmly because of a "not invented here" attitude. As mentioned before, the case may be just the opposite. A manufacturing division may not want to wait until the scientists have perfected a new product to the "n-th" degree. Their objectives are different in that the scientist wants to perform pure research by perfecting the new product and investigating all possible ways of making it better. The manufacturer, on the other hand, wants the product as soon as it will work according to specifications. He is not as interested in new contributions to knowledge as the scientist is.

Individuals possess differences in personality and character that create a variety of barriers to cooperation. Because of the basic organizational structure with its chain of command, each worker has a certain status, echelon, or rank. One doesn't cross or jump these lines in the chain of command without a very good reason. This situation will hinder communication between groups that could both benefit from a closer contact. In scientific research this condition is less serious than in the other operating divisions of a company, but a worker is still hesitant to seek consultation with someone higher in status than himself.

A worker's own job classification may label his rank so precisely that he will not freely contact others unless he is told to do so. A research liaison group member visiting this individual can obtain specific information and data and pass it along to those needing it. Some scientists are often lax in preparing clear and concise reports of their work. The liaison team can supply technical writers and sample reports for the scientist to use as a guide. They can suggest the scope of material to be included in a particular report because of a knowledge of the user's interest or activities.

Of growing significance is the threat of union pressure and job jurisdiction is preventing some technicians and production specialists from communicating directly with each other. The union may define too strictly an individual's duties and take the attitude that all other work is none of of his business. The work of a liaison member in contacting these persons directly may help in securing very valuable information needed by others in the factory.

Scientists often have peculiar characteristics that are unique in originality, imagination, or inventiveness but leave him poorly adjusted to his company and scientific community. The fear of making a fool of himself may prevent a scientist from disclosing a very valuable invention. He may keep it to himself too long and thereby reduce its potential benefit to the company. A researcher may unjustly fear the loss of reward since an early disclosure of his work places it in the hand of others for further development. Some researchers hit upon a good idea for the solution of some problem and then stubbornly refuse to consider any alternatives.

Most useful communicating of technical information is across channels. Often a scientist will get into the habit of talking up the chain of command because talking is a gratifying substitute for moving upwards. The information given to his superior is usually of little interest or benefit while the ones really desiring that information may never get it. On the same level, a person may not be eager to contact the one individual seeking his aid but will go to another because of friendship, admiration, or position. A liaison group talking to these various persons can get the information requested by other groups and can pass it along in a congruous and complete form.

Another factor hindering full cooperation between departments is the fact that they each have their own set of activities and responsibilities. Although they may each be associated with one particular project, they still have varying degrees of involvement in that mutual effort. A program may be vital to one group and only routine to another. To still another group, involvement in the project would be a real nuisance. For instance, a scientist may be very interested in completing some phase of his work. A machine shop foreman in another division may be called upon to make a part or model for the scientist. It is easy to see which party would consider this project a nuisance, especially after repeated experiences with the same individual. Certain research activities may be important to a group for the moment but then interest may shift away to some other area. For sustained information flow until the project has reached its conclusion a liaison group would maintain an effective communication link.

In recent years a new form of research organization has greatly simplified the liaison problem. This is the "project" form of organization where a team of specialists group together for the solution or completion of one single objective. The group has an autonomous function in relation to the rest of the company and therefore overcomes involvement differences. A group leader is put in charge and liaison relations can be conducted more efficiently since focus has been placed on one goal or objective. At the completion of the work the team is reinstated in their regular positions in the laboratory and are available for new projects coming up.

Legal and procedural differences may limit the flow of information within the company. The mechanics of communication may be so burdensome that researchers will just give up and not make the very contact someone could benefit from. Some industrial departments may be run so rigidly that its technicians would not consider initiating a contact because it wouldn't be right not to go through channels. Liaison relations conducted by a special team for this purpose would be company-wide in its association and would not be restricted by line commands and the like.

Communication may be discouraged because of a geographical separation between the cooperating parties. With a highly decentralized company the research laboratory may be situated at a very remote location from the rest of the plant buildings. This has some advantages, of course, in relieving the research staff of most of the pressures of production problems and stimulates a creative environment.

On the other hand, liaison is made much harder and some form of official information channel has to be established.

Timing is also a block to effective continuity in the flow of information between the research laboratory and the other functions of the company. Different working shifts will prevent some employees from ever making personal contacts with others. Absences sometimes prevent an important meeting as well as the amount of spare time at the hand of the researchers. Turnover in personnel can be considered a time barrier to the continuance of established relations between groups or departments. Records may keep information from forever being lost but can not too effectively maintain the actual flow of that information.

Liaison relations also have a diminishing effectiveness with time. When the original contacts are made, each group becomes acquainted with the other and relations become closer. A period follows when information is exchanged with maximum of effectiveness. The particular projects are successfully completed and the communication performed is completely adequate. Later, however, with no immediate reason for continuing relations there is a fall-off in mutual interest and the contacts begins to loosen. Only with a renewed effort in the form of new personnel or a new project can these relations be restored to full effectiveness. A good liaison group can help in lengthening the period of maximum effectiveness between cooperating groups. If the two groups have had many previous occasions to work together, the problem is made easier because of a closer unity in their individual histories. Personal friendships between individuals in separate departments, especially the department heads, will make communication and cooperation that much easier. Each side must respect the other's objectives and efforts. Interference or disregard for these departmental responsibilities may create a hostility between them that precludes any future cooperation. Each group must understand the capabilities and activities of the other. They must learn to use the other's "language" and the meaning of technical terms and the standards used.

Management may inadvertently block useful disclosures and transmission of research results by improper recognition and reward. A scientist will be discouraged from freely publicizing any of his work if some other group constantly reaps the credit for these accomplishments. Suggestions offered should be credited to their rightful source. Management is solely responsible for an adequate incentive plan in research. A bonus system for all originators of new patents, a merit wage increase, or a paid holiday will keep the individual researchers cooperating to release new inventions or process improvements at an early date. Their assistance in the transition of that product to the later stages of development and production will be assured.

Planning Liaison Relations (84-91)

On management falls the responsibility of setting in motion a liaison plan whereby all the necessary information is transferred when and where it is needed. One way of aiding this relationship is to establish company-wide interest in proposed research work, the status of research work in progress, and information on research work already completed and available. Management, as well as divisional supervision, should become research-minded and then try to pass down this philosophy to their subordinates. Continuous backing by management in the liaison program is essential if full utilization is to be made of research results. This does not mean that periodic reviews of the progress of the liaison plan should not be made. Possible improvements should always be incorporated into the system. What is not desirable is a fluctuation in management's support of the liaison program.

IV. Case Study

ABC Electric Company*

The actual field work in this case study was carried out at the Research Division of the ABC Electric Company, a multi-plant firm in the New England area. This company's experience covers both the commercial and military electronics

*The name of the firm has been disguised.

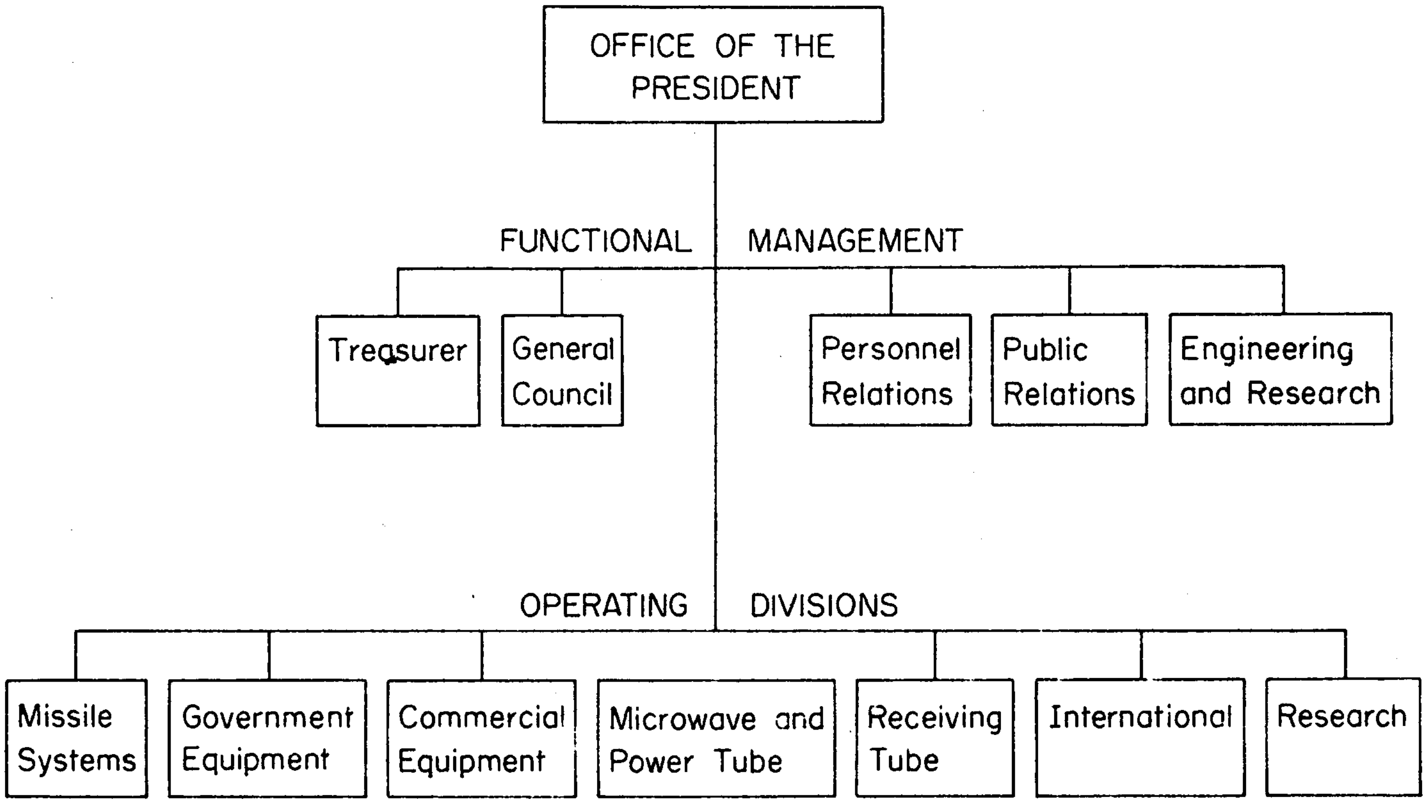
line. Spending over $2 million annually in recent years for indirect research carried on in its centralized laboratory, the company has long maintained an extensive scientific program. The nature of the electronics industry demands a high degree of technical and scientific knowledge merely to produce existing products. Consequently, most advances stem directly from the application of scientific research. Since the corporate management of ABC Electric Company wishes to be assured of a strong research and development program, scientific groups have been organized in a central research laboratory and in several manufacturing divisions. This study is directed primarily at the liaison problem existing at the central research laboratory.

To gain an appreciation of the magnitude of the operations at the ABC Electric Company, it should be noted that close to 40,000 people are employed and annual gross sales in 1959 approached $400 million.*

The Liaison Problem

Many of the problems connected with liaison relations are associated with the organizational structure of the firm and its many departments and divisions. Although an organizational chart such as that shown as Chart V is useful in understanding the division of functions

*These and other statistics mentioned later were obtained by personal interviews with research supervisors at the ABC Electric Company.



Source: ABC Electric Company

CHART V. ABC ELECTRIC COMPANY ORGANIZATION and responsibilities in an organization, the information and communication channels within the organization are of great importance in understanding the problems of liaison and coordination of research.

An attempt was made in the personal interviews and questionnaires to determine the inter-relation of divisions and the principal sources and users of research information. Interviews were held with several members of the research staff to obtain specific information regarding liaison relations within and without the research group at the ABC Electric Company.

During the first few years following the organization of the Research Division, emphasis was placed on the development of devices and components. Many valuable contributions have been made to the company's long list of electronic products. Commensurate with the growth of the company and its research activities, the Research Division's interests have diversified and now cover a broad range of activities. Direct component development has now been transferred to the proper manufacturing divisions of the company. The present functions of the Research Division include:*

1. Exploratory and basic research in selected areas of science which hold promise for the development of systems and products of potential interest to the ABC Electric Company.

*Research Division Charter, as amended, 1959, ABC Electric Company (The name of the firm has been disguised.)

2. Study and research for the purpose of keeping abreast of scientific progress in broad fields of company interest.

3. Development of new materials, components or systems.

4. Advice and assistance to management and the operating divisions.

Before each of the operating divisions was assigned the responsibility for its own growth and product development, only informal research and associated studies were carried on in these divisions. The Research Division was the major source of most new product and equipment systems. Initial studies were conducted in this division and if a new invention looked promising, a development program would be started. Upon completion of the major stages in each new product's development, it would be transferred to an operating division for manufacture. The production and sales function were entirely separated from the research phase. Without a proper evaluation of product choice due to a lack of any formal liaison with the sales department, many scientists engaged in work of little interest to the company. The research results were always interesting to the scientists but seldom found any direct application in company products. Management offered no formal plan of study but merely gave their support from time-to-time. Often the success of one project would result in management financing an increased number of research studies regardless of the topic. This led to a squandering of corporate funds with no real assurance of useful results.

Technical liaison was done on only the most informal basis with the solution of some problems being considered a miracle. New inventions were transferred to the operating divisions successfully only because of the extra effort and capability of a few worthy individuals. Information only flowed to that one group specifically interested in the product. Liaison was ineffective across divisional lines.

To improve this situation a single liaison scientist was hired, part time, to act as a "go-between" during the transition of a new invention. By contacting the several research projects being conducted, this individual collected information of all kinds but failed to pass it along. He built up a huge file of very interesting but useless data. His actual function was no more than a file clerk. He was supposed to serve also as a consultant but his background was limited as he had had only limited industrial work experience. His regular job was that of a university instructor. Not being given any authority to enforce his recommendations, his service was of little benefit to the company, being quickly forgotten. In recent months the management of the ABC Electric Company has recognized the growing importance of its research program. Both foreign and domestic competition as well as defense requirements being met by this company make the problem of improving their industrial research effort one of major significance. A total scientific and engineering staff of 4500 is presently employed.* A formal and workable liaison program has not yet been established at the Research Division but the need for such a plan has already been recognized. A better liaison relationship with the other divisions of the company should soon become a reality. The responsibility for this plan rests with the Vice President for Research and Engineering, a staff function. Its location in the corporate organization of the ABC Electric Company is shown on Chart V on the far right-hand side at the functional management level. The exchange of research information will be greatly facilitated when an enlarged liaison team has been established.

Research funding is accomplished by taxing each of the operating divisions (See Chart V) according to its gross sales and re-allocating these funds according to each division's research capability. Because of its specialized staff and equipment the Research Division is, quite naturally, the prime recipient of funds under these conditions. Therefore, the best way for a manufacturing division to receive adequate compensation for its dollar contribution is to maintain close contact with the Research Division. It should make its needs known and watch for any

*December 1959.

new product being developed that it might be able to manufacture. At the present time, no such close relationships exist. A liaison group would overcome this difficulty and smooth the way for product introduction and transition to the divisions. Although the Research Division is not primarily device oriented now, each division makes known what general types of new inventions they would really benefit by having. Technical problems are brought to the attention of research personnel only through personal friends or acquaintances. There is no "clearing-house" for the classification of production or engineering questions with a reference list of specialists able to assist on these problems.

Most research contracts from outside sponsors are negotiated rather than bid. Although the manager of the Research Division seeks this business himself it is quite common for a scientist to arrange to acquire such contracts on his own. The scientists often meet military and other customers at professional conferences and seminars where they have a chance to make known their company's capabilities and interests in certain types of contracts. Management should not have to rely on contracts being sought by the researchers in this way. A liaison group, cooperating with the research manager, should be the front-line contact in these circumstances, not the individual scientists.

Such a team could do a better job in enlightening prospective customers about the company, its products, research achievements, and present capabilities. The company would obtain for itself a wider reputation. The liaison staff would assist in this function, the goal being an industry-wide recognition of ABC Electric Company's research capabilities.

Research Division

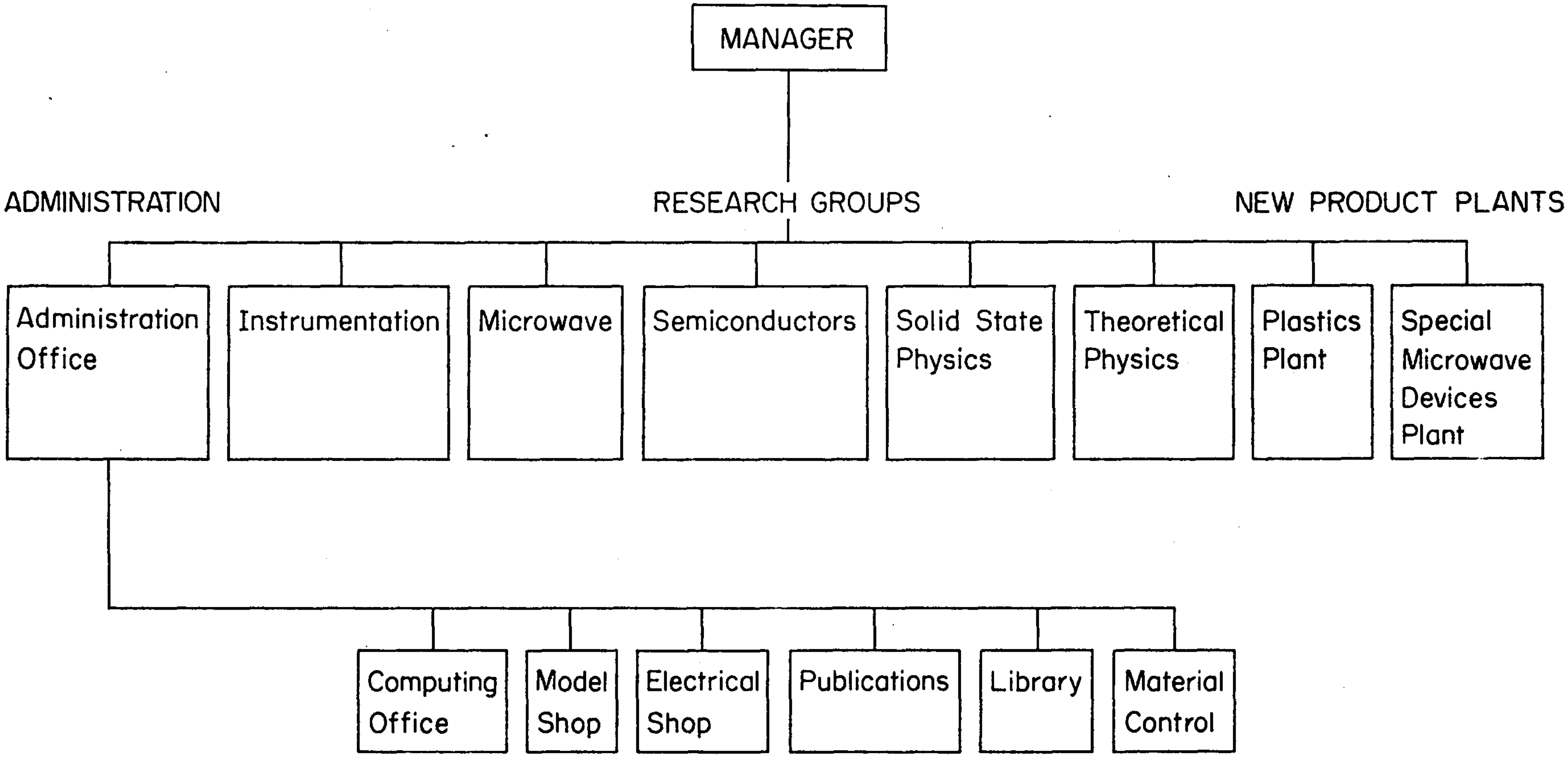
The ABC Electric Company established its Research Division to provide freedom and independence for long-range research undertaken to ensure a prosperous future. The research program must be chosen to assure an upward long-range trend in the company's earnings and a steady advancement of its relative position in the industry through extension and improvement of its product line, broadening its patent position, and strengthening its engineering capabilities.

Liaison relations for research, as just discussed, are weak at ABC Electric Company. The Research Division often undertakes work in any field of its choice with no formal review or evaluation by the other divisions. Recently the committee type of planning and evaluation of projects has been tried. Some avoidance of duplication has been accomplished but the basic desires of the several operating divisions are not being heard. The plan of the company is to have work of a purely scientific nature done in the

Research Division while development and engineering would be the responsibility of an operating division. Liaison relations conducted by a regular staff group will facilitate this division of functions. Although the Research Division was shown as an operating division in Chart V, it is primarily a corporate function. Chart VI breaks down the organization of the Research Division into its several components. Also given is an outline of research expenditures by ABC Electric Company in recent years. The values shown in Chart VII were derived from two sources; entrepreneurial activity funded directly by the company, and military or other outside sponsors of research.

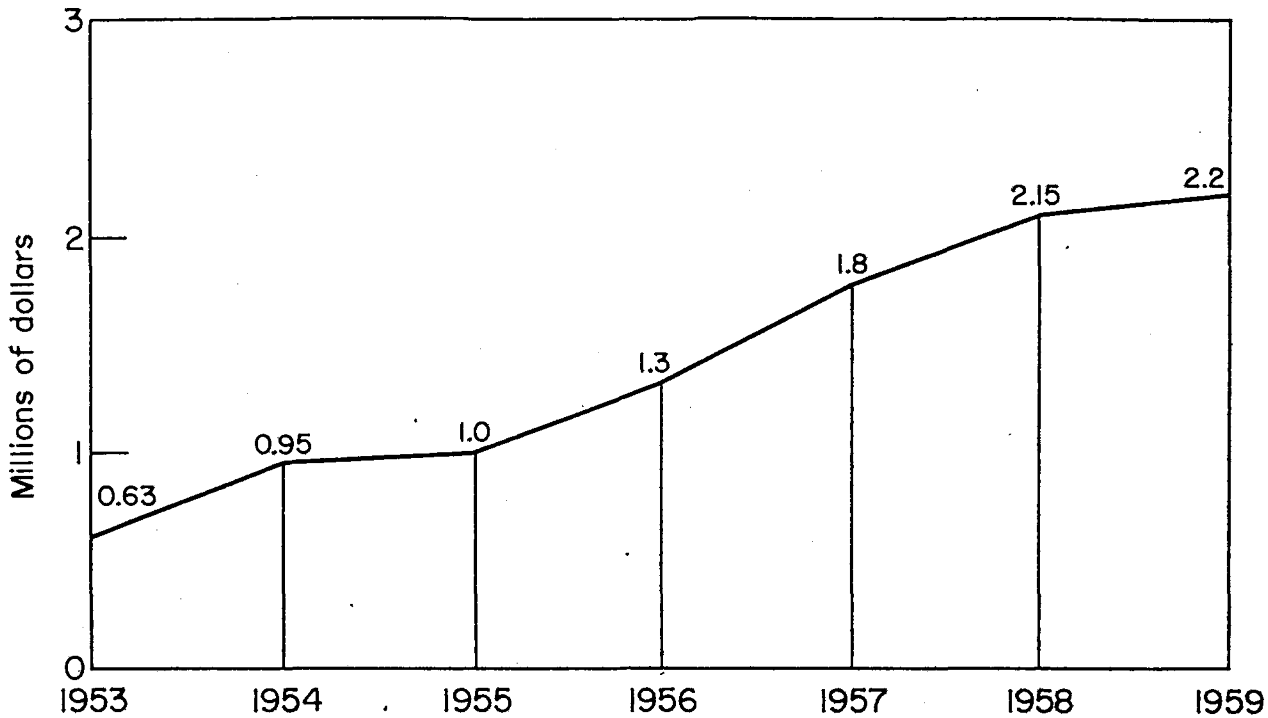
The Research Division has not yet enjoyed a very prosperous history because of many factors, among them, a serious weakness in management. Basic research is a special type of activity requiring an even, long-lasting support from management. Usually device breakthroughs take many years before completion and success. From the author's personal interviews with several of the research supervisors it was learned that this company's management has been very erratic and changeable in its support of research. Sometimes the management will feel quite optimistic about its research program and will encourage new hiring and a rapid expansion of scientific effort regardless of topic. Then, quite suddenly, management reverses itself and demands strictly short-term device oriented research, lowering costs, and the discharge of technical personnel. This attitude may be caused by the progress or failure of a pet project of one or more members of the top management staff. This policy is magnified as it is transmitted down the chain of command until it manifests itself as being completely dis-organized and seemingly arbitrary.

In addition to performing basic research and development of new devices, the Research Division performs many other services to the company and its divisions. New devices and products can be of great interest to the purely manufacturing divisions such as the Government Equipment, Commercial Equipment, and tube Divisions. Scientific advice and consultation is often given the Missile System Division. The International Division, shown next to the Research Division on Chart V, seeks scientific advice on many problems arising from its sales and servicing of company equipment overseas. The research staff is called upon frequently by all the other departments or offices of the company at one time or another to render technical assistance. At present, a person seeking advice in the Research Division calls on the telephone and gets the receptionist. She answers and tries her best to refer the party to the scientist whose specialty is requested. Usually what happens is that the right individual is never located and the caller gives up. If a regular liaison office existed, all inquiries of this nature would be directed there. The members of this



Source: ABC Electric Company

CHART VI. RESEARCH DIVISION ORGANIZATION



Source: ABC Electric Company

CHART VII. EXPENDITURES FOR RESEARCH, RESEARCH DIVISION, ABC ELECTRIC COMPANY, 1953 - 1959 liaison group would know the exact person to call within the Research Division or company-wide. They would maintain a file of all current and past research activity, including those projects being carried on in the divisions. The liaison office would serve as a sort of information "clearing-house" for such technical inquiries that come up.

The Research Division activities also include studies and scientific research to keep the company abreast of competition in the technical fields the company specializes in. These would be primarily electronics, physics, and chemistry. Research projects in these fields are currently active in the division. The Research Division has carried many of its programs past the research stage. Chart VI lists two such activities that were developed from research, pilot plants set up, and later complete manufacturing facilities established. These are the Plastic Plant and the Special Microwave Devices Plant.*

With the growth and advancements made by ABC Electric Company in the electronics industry, the Research Division has taken on a new function in the recruitment of new scientists and engineers of high calibre. After they have been acquainted with the many phases of company activity they can transfer from research work to a position

*This plan is quite common in Europe. Here the liaison problem is virtually eliminated since the scientists themselves set up the manufacturing line and then even assist in the selling of the products (92-95).

of higher responsibility in one of the other divisions. By having the Research Division recruit top scientists in this way a capable engineering staff is maintained. These people have gained a broader understanding of company activities, having worked in the Research Division and at least one other operating plant, and become valuable administrators in many management positions of the firm. Nearly every division managership, as well as many corporate staff positions, have been filled in this manner.

The many functions of company activity at ABC Electric Company have been broken up and divided into so many divisions and departments that even the minimum amount of planning and coordination that has been found necessary requires a moderate flow of information and group cooperation. The research function has operated without a formal liaison group, however, and the result has been insufficient communications and research coordination. The efforts of the one single consultant hired part-time from the staff of a local university had little effect in establishing any workable liaison plan.

The Research Division manager cannot explain how some projects are ever successfully completed and transferred to an operating division. His only comment was, "word just gets around somehow." Admittedly, the results of research are not being applied by formal planning and advance liaison. There are many other reasons for this in addition to a laxness on the part of management alone to establish a liaison plan. Many of the barriers to communication outlined earlier manifest themselves as major problems at the Research Division of ABC Electric Company. The seriousness of the liaison problem can best be illustrated by citing some specific examples.

Liaison Problems of the Research Division

There are many hazards to effective communication of technical information from the research activity to the rest of the company. By analyzing these obstacles we can determine their effect on the research program and the best methods of remedying each situation. The Research Division is presently composed of about 75 scientists and engineers with a supporting team of 100 technicians. Although the academic proficiency of certain of these members has never been forgotten, nevertheless most of the research activities are conducted in an extremely informal atmosphere, supposedly conducive to creativity and inventive imagination. Each researcher's assignment is, at best, only very loosely directed. As a result, researchers often attempt to contact members in other divisions on their own, without going through channels. The concept of a chain of command in line organizations is unfamiliar to them. Since there exist no exact "opposites" to them in other divisions, with regard to rank or echelon, the contacts are usually considered as a waste of time by the other end and are consequently discouraged. It may not be the individual contacted who creates this difficulty but his immediate supervisor. The time spent by this individual may be considered as a neglect of his regular duties, since such liaison work is the responsibility of the foreman or manager.

An outside "third party," such as a research liaison group, can perform a very useful function at the Research Division. Determining the optimum time for product transition from research to the later stages, such as manufacturing, should not always be left up to the judgment of the scientists, but this has usually been the case. Because of the nature of basic research, with new contributions to knowledge always possible with further effort, a project may never be completed in the eyes of the researchers. An unbiased group having prior contact with the using divisions is usually a better judge of the exact time a project is effectively completed in the best interests of the company. This is a current problem in the Research Division because the status of many projects are seldom divulged early enough for optimum application as new products and devices, except in the case of government and other outside contracts where quarterly progress reports are compulsory. Although the ABC Electric Company has a bonus plan for its scientists receiving U. S. patents, there is still some hesitancy on their part in disclosing the results of a particular experiment. They have a fear of being incomplete and leaving out some important aspect of the study that they will think of if given more time.

Several problems in group cooperation exist between the Research Division and other divisions that lend assistance, such as machine shop service. As one example, it has become a habit of research personnel to demand that these shops do their work quickly. Often they must delay their experiments until a certain part has been made for them by these shops. They have very little appreciation of existing production scheduling problems for the regular manufacturing being performed. They do not understand the shop foreman's reluctance to do their work first. The foreman has regular work scheduled and so may not get to the scientist's order for a few days or so. Hostilities result with a gradual deterioration in relations between the manufacturing division involved and the whole Research Division. Attempts to bring pressure to bear to speed up the fabrication of the scientist's work only makes things worse. Although this "courtesy" work is vital to the researcher, it is usually a nuisance to the other divisions. Even when the other divisions perform routine work for the research staff, such as the maintenance and calibration of test equipment, there still may be grumbling between them.

This has been overcome recently at ABC Electric Company's Research Division by conducting projects in a new manner. Originally, the scientific staff was composed of just one main body or pool. New assignments were made to members of this group that were free at the time. All service functions and technical aid were performed by the same body of technicians and repairmen. Shop facilities were over-crowded and the tools were constantly in disrepair because no single individual was accountable for their condition. With the new system, work is performed by special project groups. Each group is supervised by a group leader. Most of the machines and tools necessary for conducting the project are furnished to them for their own exclusive use. The research performed, then, is an autonomous function apart from other sections of the Research Division and the rest of the company. All the people working on each project are full-time with little sharing of duties or responsibilities. This eliminates the burden placed on disinterested third parties to perform a service that would be a bother to them.

This has made the problem of communication more difficult because of the new isolation of the research group from the other activities going on in the company. Before, when the scientists were having some of their work being done in the operating divisions, at least the divisions knew what research was being performed. Now, with this function completely separate there is little useful information exchange between these groups. A new liaison plan is essential if the research projects are to be effectively applied to new devices and products being made in the manufacturing divisions of the company.

Perhaps the one most important barrier to good cooperation at the ABC Electric Company is each division's preference for their own products. In recent years the several operating divisions have conducted their own new product development with the function of the Research Division including longer-range research not immediately applicable for devices or new products for any one division. This has resulted in making the manufacturing divisions more self-sufficient, having been made responsible for their own future growth. When new ideas or products do come from the Research Division they are often rejected. Each division has developed the attitude that these products were "not developed here." Transition of new items from research to manufacturing functions is therefore made very difficult. A formal liaison group, reporting to a corporate staff member, would smooth out this particular obstacle to effective cooperation. The close communication that existed with the old plan of conducting research might be replaced with one even a little better with such a liaison team acting as an intermediary link.

On the right-hand side of Chart VI is shown two new product plants that were established by the Research Division because no existing manufacturing division was currently in the special fields involved. During the period when a new plant facility is being set up by research personnel, a high degree of coordination is necessary. Transferring information and techniques from the laboratory to such a new manufacturing function requires the assistance of liaison personnel until that time when the new facility is self-sufficient and in full operation. As already mentioned, the Plastics plant and the Special Microwave Devices plant are two recent examples of entirely new manufacturing operations coming from laboratory research.

At the ABC Electric Company the problems of technical language or the interpretation of engineering terms are not so serious as the lack of company wide standardization. As one example, when transistors* were first developed by the Research Division, an obvious product for the company to develop was a military communication set. Several fine pieces of equipment were designed and built but they all had one main difficulty. Poor liaison with the Government Equipment division had resulted with the situation where no one had checked the frequencies of operation of new government equipment. The ones chosen were wrong. The equipment had been designed around out-dated specifications.

*This example can also apply directly to experiences in the development of several other semiconductor devices including the diode, varactor, and spacistor.

Even a small amount of liaison between the Research Division and the Government Equipment Division could have prevented this oversight. In the electronics business the importance of exacting specifications cannot be stressed enough. Company-wide liaison can aid in this standardization problem.

With the manufacturing divisions conducting much of their own development work, the Research Division has been placed in a more remote or isolated position. For adequate coordination and planning some liaison group assistance is very important. There should be a company-wide knowledge of the research activities going on in the laboratory as well as an understanding on the part of the research personnel on the general problems and areas of interest of the several manufacturing divisions. A liaison team can perform some valuable evaluation of new project suggestions and will enable good ideas to be brought to the attention of the proper departments. Otherwise, many potentially profitable inventions may never be noticed. The liaison group can aid management committees in their periodic review of projects and assigning revised priority ratings to them. Before deciding to discontinue, or not, a research project, it is important to have a good understanding of all company divisional needs and interests.

V. Conclusions

Importance of Effective Liaison

Liaison relations pose an important problem in industrial research today. Modern technological advancements necessarily involve the handling and channeling of many different types of information. The industrial research laboratory must co-ordinate its activities with other groups, both within and outside the company, if they are to have their research work effectively utilized for the benefit of the company. The exchange of data must be carried on at the earliest possible date in order to gain the most advantage from pre-planning and production control. Any shortening of the lead time from the first conception of a new product until the time it can be manufactured will increase the company's competitive advantage in the market.

Liaison relations enable the many departments and groups associated with the research effort to co-ordinate their activities. Mutual cooperation will help eliminate any possible duplication and a better focus can be placed on those programs possessing the highest potential return for the company. Research in industry, especially highly technical fields such as electronics, fosters the advances necessary to keep pace with the growing demands of both industrial and domestic consumers, as well as military defense requirements. Aside from national considerations, the ever-present threat of competition requires an active and productive research activity to be maintained by all industrial companies.

Management's Responsibilities

The establishment and maintenance of capable research facilities and adequate liaison relations to coordinate these activities throughout the company is a major task faced by management today. The company's ultimate growth with the rest of the industry and long-term survival rest on the ability of management to solve these problems. The development of a research program should be accompanied by formal and effective liaison relations.

Management must recognize the necessity for a research program and then formulate a progressive policy within which to establish their goals and objectives. As a first step, they should make an analysis of their particular situation. Every company has a different type of need for research activities. Some should center their attention strictly on device development. Others, like the case study company, must also perform basic studies in order to keep even abreast of progress in the industry. The research needs will vary, then, and management should let the liaison function evolve according to the specific needs for it. Some informal liaison may already exist in many situations and any attempt to improve relations should be based on previously established channels. Usually when informal cooperation has been conducted in the past it was because of a legitimate need. Any formal expansion of the liaison program should be based entirely on the needs of the research program in the company, rather than being a modern-day manifestation of "Parkinson's Law," for instance. It should also be flexible in terms of the company's changing activities in research, evolving with the need. As conditions change, so should the liaison framework change.

Before establishing liaison relations, management should define the exact responsibilities and authority of the group. Since the liaison office should be a staff function, it is best placed under a corporate officer. In the organizational structure of the Case Study company, this would come under the Vice President, Engineering and Research, shown on the right-hand side of Chart V, ABC Electric Company Organization. This will enable company-wide jurisdiction without any special ties to one division limiting its effectiveness with others. Ideally, the liaison team should be made up of former members from as many of the manufacturing divisions as possible to ensure an even representation. In this way the group will have, from the start, some knowledge, at least, of most of the company's activities. The exact scope of the team's duties and their authority should be defined by corporate directive. Once a working liaison plan has been established and relations between the research function and the rest of the company are in progress, management should not become moody or lax in its support or interest.

The qualifications (97-100) of a good liaison team member should be defined on the basis of an appraisal of the job to be done. His exact duties and characteristics will be unique for each company. However, some generalities can be put down to serve as a guide for industrial firms. A college degree in science or management is desirable because such a person will be capable of understanding the basic scientific principles and manufacturing processes, as well as having an over-all insight into the problems of the concern.

It takes more than technical know-how to be a successful liaison team member. Human relations problems arise everywhere. He has the problems of a staff man who makes recommendations and offers opinions to veteran line specialists. He must deal intimately with tempermental technical men as well as top line executives.

He must coordinate and get information out of line groups without the authority to command performance. This requires skill in human relations, a skill which one does not learn in college.

There is little doubt that a person in this type of job must be an extrovert and content when surrounded by people. A research liaison man cannot hide in his office with charts, graphs, and records. Most of the time he will be selling himself, the research department, project suggestions, the concept of cooperation, and a wide range of other information.

The ideal development pattern, then, of a research liaison member would be a college degree, several years of research or manufacturing experience, and an eager willingness to cooperate with others.

Management should also ensure a proper evolution of liaison personnel for this function. As stated, the staff should consist of research and engineering people from as many of the divisions as possible. With a scientific background possessed by each of them, and the learning of administrative duties in all phases of company activity while in the liaison group, the staff will be an excellant source of future management personnel. If a scientist has served his tour with the group and has not been promoted within management because of his being unsuited for such responsibility, or by his own choice, voluntary reinstatement in his old position should be guaranteed. With the original staffing of the liaison group being made of those interested in going on to administrative positions, this program can serve a very useful purpose in recruiting for management, in addition to its regular job of research liaison.

Responsibilities of the Liaison Group

The first and most important job of the liaison group is to establish company-wide relations and channels for the flow of technical information. This will promote a better understanding among the scattered divisions of a multi-plant firm. With each division having a knowledge of the other's needs and objectives a more uniform and co-ordinated research program can be enjoyed. These liaison relationships will add important links in the communications net. This will help prevent unexpected and paralyzing stoppages in the flow of information. Because of its company-wide scope, the group can effectively act as a technical information "clearing-house" for bringing to light new product suggestions or ideas of value which might otherwise have gone unnoticed. The group should not attempt to displace anyone in performing the communication function but should aid others in effecting their own relationships throughout the company. Also, no member of the liaison team should delve into the running of a line department. Any inquiries about its organization or command should be directed to the manager's office. Technical information, on the other hand, can be obtained first-hand at the work-place but care should be taken to avoid infringing on the manager's or foreman's own jurisdiction. A staff liaison man by-passing the foreman, for example, to obtain certain technical information can create many human relation problems.

A second major responsibility of the research liaison group is in determining what type of information to collect and what to do with it. To serve the company best they should not merely provide volumes of data for everyone, or even speed up the transfer of data, but should discover what information is actually needed and by whom in view of the decisions to be made. Then, they should see to it that the important information reaches the users in time to be useful. The collection of historical data, regardless of how interesting, is of little use unless it is within the field of interest of the user and it is received early enough to be beneficial. The liaison group should guard against merely collecting and filing away data, as they have no use themselves for technical information of any kind. Their function should be, then, only to assist in the transfer of information between and among all interested parties in the company.

The team can render additional services in many ways. Division managers and engineers can obtain a great deal of information from such a team about many aspects of the rest of the company. They can become better educated about company statistics without the burden of plant tours or orientation sessions. In this way they can get from the liaison group a better perspective of company activities, objectives, and ethics.

The policy group of management that evaluates research project suggestions should be able to gain from the liaison team important information affecting their decisions on the priority and desirability of establishing or continuing certain research studies. This committee function would be a good place for the exchange of new product ideas and research project suggestions. It should not be an arena for the clash of opposing viewpoints held by various division members and passed along to the liaison group. Discretion should be used in handling these individual opinions and all personal motives should be kept out of these project evaluation committee meetings.

Another suggestion often voiced by members of the research laboratory is the need for a technical information center. The research liaison group might be able to perform this service. It would not be difficult for them to establish a list of all current research studies as well as a directory of the technical staff of the company showing their specialties, training, and experience.

Liaison relations in research will be beneficial in improving the scientific effort within any industrial company. It is the ultimate responsibility of top-management to promote these relations before they can hope to enjoy the benefits derived therefrom.

APPENDIX

A. Acknowledgements

ABC Electric Company (The name of the firm has been disguised.)

The case study information in this thesis was obtained by personnel interviews and questionnaires put to members of the Research Division of the ABC Electric Company, a major electronics firm in the New England area. The author would like to express his grateful appreciation for their kindness and valuable help in gaining a better understanding of the background and day-to-day significance of the research liaison problem in this company. Several individuals were particularly helpful by extending extra time and specific help on several occasions. The author is indebted to the Vice President and Manager, Research Division; the program director for Semiconductor Research; and the Research Division's staff chemist.

Boston University

Appreciation is also extended to members of the teaching staff of the College of Business Administration, Boston University, for their encouragement and advice on improving the design of the study outline and a framework for the analysis of results.

B. Interviews

It is now fiting to include a brief statement of the purpose, methods, and sources used for gathering information about the case study company.

A great deal of literature touches on to some degree the thesis topic. Although a survey of these works is essential to an exhaustive study of liaison relations in industrial research, some basic material should be gathered from the field. Only by being exposed to fresh, first-hand situations existing within a company can a full appreciation and comprehension of the scope of the problem be acquired. Understanding the true significance of day-to-day corporate activity can best be achieved by either work experience or repeated plant visits.

As the thesis outline was being constructed, a list of questions was prepared and put into the form of two types of questionnaires. The first set of questions was used as a discussion guide for directed interviews conducted with seven research supervisors of the case study company. Included in these discussions were the Research Division manager, the office manager, and several project group leaders. An executive from the Office of the Vice President for Research and Engineering was interviewed to learn of management's viewpoint and opinions on the subject of research liaison. The second set of questions was chosen for non-supervisory research personnel.

Interviews and other conversations were held with several members of the scientific staff and their technicians. Because of the author's work experience and daily contact within the laboratory, it is difficult to specify exactly what constitutes a formal interview as opposed to repeated casual conversations or answers to questionnaires sent out. Of the non-supervisory scientific work force, approximately half, or fifty, were contacted with significant information of direct interest to the thesis being obtained. This provided a conveniently broad base of data to add to that acquired from the supervisory staff.

Sample questions from those ask both supervisory and non-supervisory members of the laboratory are now presented.

The following questions were used as a guide to interview research supervisors.

Q-1 Has the problem of technical liaison and coordination of research been made more difficult with your company's new policy of research and development decentralization to the several divisions?

Q-2 What do you think should be the scope of current Research Division activity?

Q-3 What company divisions or outside customers sponsor research work here in the Research Division?

Q-4 Can periodic committee meetings effectively plan and coordinate all company research work?

Q-5 Would a full-time liaison group or team aid in over-all coordination of research activity?

Q-6 Should the scope of activity of a research liaison group be company-wide or restricted to specific company divisions only?

Q-7 Where would a research liaison group be placed in the corporate organizational structure?

Q-8 What rank or authority would such a liaison group be given in order to minimize the normal barriers to effective cooperation caused by vertical corporate structure separation with those persons contacted?

Q-9 What individuals should staff such a research liaison group?

Q-10 What are the mechanisms used now for technical research information exchange?

Q-11 How does management choose new research projects and evaluate current ones in determining the scope of its research activity?

C. Questionnaires

In order to provide a broader base of data with which to learn and analyze the liaison situation at the ABC Electric Company's Research Division a canvass of the scientific staff and their technicians was made. This was performed by sending a set of prepared questions to members of the research staff. An outline of the questionnaires sent out is shown below.

Q-1 Who does a scientist seek aid from when seeking technical facts or opinions?

Q-2 What are the sources for new research projects?

Q-3 Who contributes to the solution of problems in your area of interest?

Q-4 Who screens or evaluates projects for priority or continued funding?

Q-5 For what reasons were projects known to you rejected?

Q-6 Assuming limited corporate funding, what do you think would be the best long-range research projects?

Q-7 Has any research project related to you been neglected without a satisfactory reason given by your supervisor?

Q-8 Is the present method of scientific liaison to the rest of the company adequate?

Q-9 What other divisions are you dependant on for work?

Q-10 What is the method used when communicating research results to a company division planning to apply those results in a new product?

Q-11 Are you interested in having a liaison group or team serving as an active intermediary between the research laboratory and the rest of the company?

Q-12 Would you be willing to spend part of your time as a member of such a liaison group?

Q-13 Do you know in general what projects are currently active in the Research Division?

Q-14 Do you know the special function or product manufactured by each of ABC Electric Company's several divisions?

Q-15 Have you ever suggested a research project that you thought would benefit the company? Was it adopted or rejected?

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