The Charles Babbage Institute (CBI) was founded in 1978 by an alliance of industrialists, professionals, and academicians to record and study the evolution and use of the digital computer and modern electronic communication technology. CBI is a research institute dedicated to promoting the study of the history of information processing, bringing historical perspective to the study of its impact on society, and fostering the development of historical archives in the area of information processing. Located on the campus of the University of Minnesota (Minneapolis), CBI maintains an archival collection consisting of the records of individuals and businesses, computer manuals, product literature, photographs, oral history interviews, and reference material for use by researchers.


This guide is distributed by the Society of American Archivists, 600 S. Federal, Suite 504 Chicago, IL 60605 and was prepared under a grant from the National Historical Publications and Records Commission, Grant 87-47.

Acknowledgements

The authors are grateful to the National Historical Publications and Records Commission for funding the project and underwriting the production and distribution of this document. We are indebted to the Control Data Corporation for making its records and employees available to us. We were particularly fortunate in receiving the assistance of Scott Jessee and Patricia Utterberg of the Control Data Corporation Historical Archives and Mollie Houns of the Control Data's Communications Department. John K. Smith and Jeffrey L. Sturchio helped to provide the authors with examples for the guide from their own work. We received valuable advice from Anne Millbrooke, archivist of United Technologies, and Steven W. Usselman, professor of history at the University of North Carolina at Charlotte, who each reviewed a draft of the guide. Finally, a special acknowledgement is owed to Arthur L. Norberg and William Aspray, formerly of the Charles Babbage Institute, who assisted the project from its inception to its conclusion.

This guide is, in part, a product of CBI's National Collecting Strategy program for preserving the historic records of computing. This three-year program was made possible through the generous support of the:

AT&T Foundation
IBM Corporation
Andrew Mellon Foundation
Unisys Corporation

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INTRODUCTION

For archivists and historians alike, the large, high-technology company is among the most difficult of institutions to document. Like most large businesses, it produces an enormous volume of records. But unlike other businesses, it is driven by rapidly changing technology, relies heavily on research and development, and generates a large amount of technical records. All of these factors complicate the historian's search for adequate sources and the archivist's task of documenting the most historically important aspects of a company. The effectiveness of both the historian and the archivist is increased the more they know about the firm's general history, its organization, and its production of records. Yet this information is often difficult to obtain prior to a search for records. Archivists have criticized themselves for appraising records without the background to make informed decisions. Historians who are unfamiliar with the structure of the modern, high-technology business are similarly disadvantaged in their ability to uncover information vital to their research. In order to better equip the two professions to document high-technology industry, this guide presents a generic description of industrial activity in the high-technology environment, and introduces a probe technique for obtaining general historical and documentary information about these companies.

The impetus for this work arose from concern of the Charles Babbage Institute (CBI) about the state of historical documentation of the computer industry. Industry is arguably the most important sector of computing and other high technologies, particularly for its role in moving technology into society. Familiarity with the records of computer companies has been a foremost priority for the staff of CBI. In a study of Engineering Research Associates (ERA), Eckert-Mauchly Computer Corporation, and Remington Rand Corporation, staff members examined records of Sperry Rand's Univac Division held at the Hagley Library, the Unisys Corporate Archives, and certain records at IBM's Corporate Archives. The staff conducted a survey of records held by one segment of Sperry Rand Corporation in order to locate other sources about ERA. In preparation for this guide, CBI surveyed the corporate records of the Control Data Corporation. Individual staff members also had records experience with other high-technology industries.

Despite this considerable experience in locating historical records not already in archives, the staff has been regularly frustrated by voluminous records, the continually changing organizational structure of companies, and the paucity of background information. It is these

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three elements that make the selection and preservation of business records so difficult. A large company can have hundreds of organizational units, each continuously producing, distributing, and duplicating records. The company itself is in a dynamic state that affects the production of records. Units are combined and discontinued, new units are created, personnel are constantly changed, and entire companies are merged, acquired, and divested. It is a daunting task for the historian even to locate inactive records in this fluid environment. Much more is expected of the archivist, who must document the company in a way that satisfies the needs and expectations of many different users.

The high-technology dimension presents further problems. The predominant characteristics of these companies have a marked effect on the type of documentation they produce. High-technology businesses specialize in technological innovation, and depend on strong research and development programs involving sizable technical staffs. Industries that are included in this group are aerospace, biological, chemical, communications, computing, electronics, medical equipment, pharmaceutical, and test equipment. Many of the records they produce are technical in nature, and any judgement about their historical value requires specialized knowledge. Because the success of high-technology companies often hinges on their ability to develop innovative products, organizational and personnel changes may occur at a faster pace than that of other industries. For example, in the computer and communications industries, entire product lines typically become obsolete within three to five years. This environment affects the production of records, and the ability of archivists and historians to adequately select among them.

The inadequacy of information about business, its structure, and its documentation is a common theme in recent archival literature about business records. JoAnne Yates looked at the effect of business structure on appraisal, drawing from the historical work of Alfred D. Chandler, Jr., most notably his The Visible Hand (1977), which examined the evolution of corporate structure from the small, unitary business to the multidivisional corporation. Francis X. Blouin has also seen value in developing models of corporate structure to improve appraisal decisions, and has argued further for better comprehension of record keeping, its structure, and its effect on companies as an aid to understanding the documentation produced by businesses. Michael Lutzker has looked to sociology for a framework of a bureaucratic

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2 The difficulties in appraising the records of science and technology were highlighted in the final report of Joint Committee on Archives of Science and Technology, Understanding Progress as Process (Chicago: Society of American Archivists, 1983).


4 Francis X. Blouin, Jr., "A New Perspective on the Appraisal of Business Records," American Archivist 42 (July 1979): 312-320. See also his "An Agenda for the Appraisal of Business Records" in Archival Choices: Managing the Historical Record in an Age of
model of an organization and how it might establish a more theoretical basis for appraisal decisions.⁵

Clearly, there is a need for different models to familiarize archivists, as well as historians, with the organization and practices of businesses. There are few sources that fill this requirement for business in general, and none to pilot archivists and historians through the high-technology company. This guide satisfies the latter need by offering a description of industrial activity. Seven business functions are described: planning, basic research, research and development, production, marketing, sales, and product support and enhancement. Legal, financial, and other basic support services that cut across these seven functions are also covered. The discussion of each of these business functions is divided into three sections that deal, respectively, with the definition of the function and a description of the activities associated with it, the documentation typically created within the function, and additional observations, designed to both illustrate the first two levels with specific examples and provide additional guidance to "real world" processes and documentation problems. This discussion concentrates on those areas that are most distinctive in high-technology; it also may be valid for other industries.

The notion of a serial process that flows from planning through basic research, research and development, production, marketing, sales, and product support and enhancement is, like any model, a simplification whose limitations will be obvious to anyone who has worked in an industrial setting. For anyone without industrial experience, its simplicity is its strength. A historian not having knowledge of this process would have need to acquire it in order to understand how a company functions. An archivist faced with the task of documenting a high-technology company would be handicapped without a basic understanding of this process.

For archivists, the description of industrial activity is more than a model of business functions; it can be used as a guide to appraisal. Better appraisal methods have been cited again and again as the key to making sense of the process of appraising business records. However, most articles on selecting business records tend to be too simplistic in their prescription (e.g., "save all executive correspondence..."). It is the nature of appraisal that makes the prescriptive approach unsatisfactory; yet, the more precise the criteria, the less applicable they are to any given situation. As the work of the archivists Frank Boles and Julia Marks Young recently demonstrated, archival appraisal can involve over fifty factors, many being unique.

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to a specific situation. In order to avoid this problem, we have borrowed an approach used by archivists at the Massachusetts Institute of Technology in developing their *Appraising the Records of Modern Science and Technology: A Guide*. That work divides the scientific and technological processes into their components and describes the documentation likely to be associated with each process. Their guide, which focuses on science and technology in academic settings, was developed with the belief that appraisal requires understanding of the activities involved in science and technology, and that the goal of the archivist is to preserve records that best document each important activity. Those interested in industry can learn from the MIT guide, but it does not examine many important differences between industrial and academic activities, and between the records the two sectors generate.

While the generic description will help archivists and historians contend with the records of high-technology business, still more must be known about the history, structure, and documentation of any company before its records can be selected and studied effectively. Often, archivists and historians acquire this information as they survey records, and sometimes they excel at extracting it from even a cursory examination. However, the procedure is deficient when it concerns voluminous records in a large, complex company. Too much vital information might be missed. Sometimes, historical information can be obtained from other sources, but it is rarely comprehensive or well-balanced for companies in newer, high-technology industries. Without such information, how can one ascertain what events, activities, or issues are worth documenting?

The use of documentary probes offers one effective and practical method for developing this information. A documentary probe is a product study that generates diverse historical, organizational, and documentary information from all facets of a company in order to aid in the selection of historically valuable records. A probe uses prior research, interviews, records surveying, and the description of industrial activity to identify historical issues that should be documented, to ascertain how well those issues are represented by extant documentation, and to identify other areas needing to be documented. It involves an iterative process, building and refining the scope of the probe as more knowledge is obtained.

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8 A similar type of "probe" was used to supplement an excellent records survey of the Department of Energy conducted by the American Institute of Physics (AIP). AIP conducted extensive searches of documentation on a selected research programs or events. See Joan N. Warnow et al, *A Study of Preservation of Documents at Department of Energy Laboratories* (New York: American Institute of Physics, 1982).
Probes are particularly suited to high-technology businesses because the products of these enterprises tend to move through most of the functions of a business in a short period of time. This enables the probe to generate information from most, if not all, historically important parts of a company. The scope of information will be broader if the choice of product for a probe is based on the product's pervasiveness in the activities or strategy of the company, its effect on the company, and, to a lesser degree, its importance beyond the company. A series of probes may be employed to capture general information beyond the time period of one product, and thus will yield historical and documentary information applicable to the entire company throughout its history.

The description of industrial activity has a critical role in the execution of a probe; it is used to gauge the fullness of documentation available for a product. For example, a probe of a laser scanning device would involve, among other things, locating information about its marketing. Our description of marketing suggests that a market plan is developed for all products. If a planning document was not found, there might be activities within planning that would otherwise document the marketing of the device. Interviews can be used cautiously in lieu of paper records. In this fashion, documentation is led by an analysis of activities important to the history of the product, not by the records that happen to remain.

It is this aspect of documentary probes that offers an important improvement over the straightforward records survey. Surveying is the standard technique used both by archivists and historians to locate records in a business. Archivists methodically examine groups of records to determine their subject matter, age, condition, and historical relevance. Historians follow the same practice, though their search is usually more narrowly defined, and they are apt to spend more time examining individual records than record groups or "series." The primary weakness of surveying is that it is focused first on extant records, not historical issues. Probes reverse that emphasis by developing a picture of what should be documented even before records are examined. The description of industrial activity suggests the type of activities and records that occur within a business. The picture is completed for each specific product through interviewing and prior research. At that point records can be most profitably surveyed.

The description of industrial activity is contained in the first part of the guide. The second part describes the application of documentary probes in high-technology businesses and provides a case study of a probe conducted at the Control Data Corporation. A section in the appendix provides commentary about the effect of corporate acquisition on documentation. These aids have been developed specifically for high-technology businesses, but with little modification it is likely that they may be profitably used in general business settings. They may be employed by an individual archivist or historian, or used in multi-institutional projects designed to improve documentation for a specific area of interest. In particular, novices to the business environment will benefit from the information presented in this guide. But those who are familiar with business will also benefit by using the guide as a tool to understand the anomalies of high-technology industry, instruct archives and history
students, and develop strategies for researching and documenting the history of individual companies.
A DESCRIPTION OF INDUSTRIAL ACTIVITY
AND DOCUMENTATION
This part of the guide contains a detailed discussion of high-technology industrial activity and its documentation. It has been developed to provide historians and archivists with a model that can be used to understand the operation of a high-technology firm and locate records that best document its activity. The description portrays industrial activity as a series of distinct functions, rather than as operations performed by various departments in a company. Businesses may be organized differently from one another, and the structure of a given corporation may change over time, but the types of activities remain mostly constant. We feel that this emphasis on understanding activity has been missing from archival methodology and may be fruitfully used by historians in their research of a high-technology firm.

The model incorporates two categories of activities: principal business functions and support services. The seven business functions are planning, basic research, research and development, production, marketing, sales, and product support and enhancement. The support services include legal, financial, and seven other services. The principal business functions are the primary focus of this guide because they represent the progression of events that is central to products of high-technology industry. The discussion of each of these functions is divided into three sections that describe, respectively, the activity, the documentation, and special considerations in documenting the activity.

The first section presents an overview of the function and describes the activities within it. This section is illustrated with examples taken from our research and historical literature. The relation and overlap of the function with other functions is also described. The line between two functions is not always distinct, and it is important for those interested in the organization and documentation of these activities to understand how the transition is made.

The second section is a description of documentation typically created from the activity. Its purposes are to provide a checklist of records that are commonly associated with each function and to outline general types of records. The section includes those records that might have historical value; it does not recommend which records should be preserved. Records are described in generic terms, avoiding nomenclature specific to one company.

The third section consists of additional observations, designed both to highlight difficulties in documenting certain industrial activities and to provide additional guidance to anomalies relating to high-technology documentation. It describes the uses of some key records, the effect of the company's organization on the production and disposition of records, the role of non-paper records, and the historical value of certain important types of records.

We have treated support services differently from the principal business functions in two respects. First, support services do not concentrate on a single industrial function but serve
to support most business functions. Second, the interaction of services with other business functions is likely to extend over a considerable portion of the overall product life-cycle. Two of these services, financial and legal support, receive the same three-level treatment given to the business functions; they seem to be those most central to high-technology industrial activities and their documentation. An additional seven support areas have been described more briefly. They are facilities, libraries, personnel, public relations, purchasing, records management, and traffic. Though most have been selected because of their overall importance in supporting the operations of the company, some have been chosen because of their significant role in records keeping.

Because much of the research for this study focused on the Control Data Corporation, many of the examples in the description come from that company's history. However, we are confident that the descriptions are broadly applicable across high-technology industries such as electronics, computers, chemicals, and aerospace. The description is most effective for companies with tangible products because we have concentrated on high-technology manufacturers. Archivists and historians studying firms engaged in services (consulting, data processing bureaus, maintenance, etc.) will need to compensate by deemphasizing some functions (like production) and emphasizing others. Collectively, the staff of the Charles Babbage Institute has worked with a variety of companies, predominantly in the computer industry. This base of knowledge was expanded by reviewing historical works about high-technology businesses, and consulting with colleagues in history and archives with experience in other high-technology businesses.

In part, the description of industrial activity was developed to encourage archivists to look beyond paper records by focusing first on the activities of high-technology industry and then selecting the records that best document the activities. There is no doubt that paper records remain the most prevalent form of formal business communication. Our experience and research indicates that paper records still predominate, and the lists of record types in the second section of the descriptions reflect this situation. However, new technologies are rapidly changing the nature of business records. Historians and archivists should be alert to the importance of non-paper records, including machine-readable files and artifacts. The automated office may never appear in its idealized form, but aspects of it were uncovered in our research and are well-established in many corporate offices.

While it is probable that the general patterns of industrial activity in high technology are largely independent of national setting, we have not done the research that would enable us to claim that the activities and documentation patterns described are followed outside the United States. Hence, this is foremost a guide to the activities and documentation of industrial high technology in the U.S. We have no doubt that many parts of the description
may be successfully applied to firms outside of the U.S., as well as outside the high-technology industry.  

The description portrays the workings of high-technology industry as orderly, progressing neatly through sequential stages. In reality, corporations are not necessarily organized in ways that perfectly mirror these descriptions. It is important to be attentive to the peculiarities of how things actually happened, rather than how they should have occurred. For example, different functions and support services may coexist in the same department in the corporate hierarchy. Moreover, although the stages are typical of most high-technology industrial activity, the structure of the organization in which they take place varies over time, with company size, and with company maturity.

Archivists and historians can enhance the effectiveness of the description in a "real world" situation if they consider two other factors.

First, it will be easier to identify records associated with a function if the organizational units can be matched to their corresponding function. Knowledge of corporate organization may allow one to guess where records of relevant functions are most likely to be found. Obviously, sales records are typically created by people within the sales department of a functionally organized business. Similarly, knowledge of the hierarchical position of the writer and the addressee of an internal report allows one to make assumptions about the degree of summary and analysis in the report, as well as its probable purpose. While the process of matching function with department may be straightforward, it frequently presents problems. A function like planning is typically found at many levels in a company's hierarchy. Even sales is sometimes decentralized and distributed across a business. Organizational charts offer one method of tracking organizational change, but the charts themselves rarely explain the complex and dynamic relationships between organizational units. Large businesses may formally revise the organizational chart three or four times annually. Some businesses, like United Technologies, do not produce organizational charts because they do not feel that the charts communicate meaningful information. In such cases it becomes necessary to turn to other sources of information, such as a documentary probe, in order to comprehend the organization of the company.

Second, the task of assessing the value of records will be aided by considering the flow of information in modern companies. Communication flows in several different directions. Downward communication takes the form of memoranda if directed towards one or a few people, circulars if directed towards a larger, but select group, and internal newsletters or similar company publications if directed toward an extremely broad corporate audience.

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Upward communication takes the form of periodic and special reports, which are increasingly summarized and analyzed as they move higher up the hierarchical scale. Lateral communication takes the form of interdepartmental correspondence and memoranda, which permit the coordination of activities at all corporate levels.

Sometimes historians and archivists view the records of upper-level management as the core of information about a company. After all, it is at the apex of a hierarchy that important decisions are most often made. However, the activities of a functionally organized or multidivisional corporation cannot be properly documented or understood from centralized upper-management files alone. Information is not merely summarized as it moves up the hierarchy; much of it disappears as decisions are made at lower levels. Other information never gets into the vertical flow in the first place, because it is operational in character and does not need to move to a higher authority. Yet some lower-level decisions may have a substantial effect on the company and are important to document. A full accounting of a company's critical decisions and actions requires more than the documentation of upper-management.10

A special note to archivists is required at this point. While the description contributes significantly to information needed to make valid appraisal decisions, we have resisted the practice of listing types of records that should be preserved. The availability of historical records and the resources that may be used to preserve them varies greatly from company to company. Record series judged to be invaluable in one situation might be viewed as insignificant in another. In a corporate archives, many series of records may be judged worth preserving apart from their historical value. If the records-keeping practices of each company were exactly the same, specific recommendations on each type of record could be made. Since this is not the case, we believe that it is the archivist's task to understand the universe of documentation that is likely to be found, identify those issues and activities that seem to have historical relevance, and find the records or artifacts that best document them. The description will give a good profile of the universe of documentation that typically exists in a high-technology company. Archivists seeking assistance in identifying historical issues and relevant documentation are urged to consult the part in this guide on documentary probes.

10 JoAnne Yates has argued that Alfred Chandler's work (The Visible Hand, 1977) could be used by archivists to understand the flow of communication in a modern company and its effect on documentation. She criticizes the emphasis given to documenting the "top-down" flow of information in a bureaucracy (see Yates, "Internal Communication Systems," 141-151). This is echoed by Margaret Hedstrom's analysis of corporate decision making and its implications for archivists in her "From Bosses to Bureaucrats: Social and Cultural Change in Corporate Decision Making, 1900-1970," (Paper delivered at the Annual Meeting of the Society of American Archivists, Chicago, Ill., 1986).
1. PLANNING

Planning is the process by which a company makes business decisions. It helps determine how a company will conduct business and allocate its limited resources of capital, facilities, and personnel. The planning function may be institutionalized and sophisticated, or it may be vested informally in a single individual. It may be led by technological or scientific research, or it may be developed by top executives as part of an overall corporate strategy. The formality of the planning process tends to increase with the size and bureaucratization of companies. In small start-up firms, it can be quite casual, while in large multidivisional corporations planning can be quite involved. In most cases planning is concerned with long-term goals, often five years or more.

Long-range planning became vogue during the 1950s and is now ensconced in the management of most corporations. Most planning can be divided in two areas: operating or divisional planning, and strategic planning. The former concentrates on the plans of operating units or divisions. Strategic planning involves top-level executives and strives to chart a
business' overall performance objectives and its means to future growth. Decisions relating to divestment, acquisitions, expansion, and overall research and development are made during strategic planning. Planning processes also occur within individual projects, marketing, finance, personnel, and other business activities.

There is no universally accepted model governing how planning should be organized within a corporation. The development of operating plans is often the responsibility of the heads of the various departments or divisions. Department heads typically first call on their principal subordinates to present their own projections and plans, which are then accepted, revised, or rejected. In more sophisticated studies, individual unit plans are supplemented by studies of external industrial, technological, and general economic conditions, which may be prepared by a planning department or by outsiders. From all of this, department heads devise overall department plans that identify objectives and resources that will be allocated to meet those objectives. Such plans may become elements of a general corporate plan, whereupon the company's division heads would meet under the direction of the chief executive officer.

Preparing an overall company plan involves integrating corporate strategy from the top down. Individual department plans are modified both to serve the overall corporate goals and to coordinate them with one another; there is no point for the marketing department to orchestrate a major campaign for a product if the campaign is likely to push customer interest in the product beyond the capabilities of the sales force or the production department.

Companies vary in the degree to which these planning decisions are collegial ones, but often the chief executive officer (CEO) plays a dominating role. After all, he or she is the official with the ultimate responsibility for planning and overall corporate growth, especially when major changes are made. The role of the CEO in planning tends to be dominant in start-up companies, or those firms run by founders (or founder's families) who have a major proprietary as well as executive interest in the business. Sometimes the planning process appears invisible in these companies because it is developed in the entrepreneur's mind. Overall plans are imposed from a single source, rather than reached after formal discussion. As late as 1928, when Ford had finally discontinued the Model T in favor of a massive retooling to produce the Model A, for example, "the Ford Motor Company remained a dictatorship. Henry Ford dictated broad company policy and details of the car."12

The CEO is not always the primary corporate planner. In today's business environment, the planning process for a large, multi-divisional company must consider a vast range of forces, including legislation and regulation. It is unlikely that a CEO could reasonably manage all of


12 David Hounshell, From the American System to Mass Production (Baltimore: The Johns Hopkins University Press, 1984), 293.
the information needed to produce an accurate plan. The job of the planning department is to filter unnecessary information and select important issues for consideration; this task forces the CEO to relinquish some control of planning. Of course, there are numerous examples where CEOs dominate the planning of even large corporations. Even while authority was being decentralized at Ford after 1945, Henry Ford II continued to emulate his father's management style. And while CEOs may abdicate the role of chief planner to a certain degree, a planning department is not likely to be effective if it does not have the support of the CEO or if it is low in the corporate hierarchy.

Though most businesses operate perfectly well without a planning department, many larger companies have established them. Such departments vary greatly in size and function from business to business. Most often they are established to oversee the administration of the planning system. They are also involved in forecasting, modeling, identifying critical issues, and gathering data. It is quite common to have a single individual as the planning officer; generally only large companies (over $5 billion in sales) have planning departments of more than ten staff members. Some company units will have their own planning officers; normally they will report to the head of the unit, rather than to the overall planning department or CEO.

If a product starts in research and seems promising, a decision must be made about how to develop it, or whether to develop it at all. Such was the situation when in 1947 the Rohm and Haas chemical company decided not to adopt a proposal from a team of company scientists to pursue the possibilities of acrylic emulsions as paint bases, and the 1951 reversal of that decision. Another example was the decision in 1958 by the founders of Control Data to develop Cray's new building block as a large computer to be sold to technically sophisticated users and to seek a government contract for a large mainframe to underwrite the work. A strategic plan may not always contain specific tactics to meet the plan's objectives. The acquisition of C-E-I-R by Control Data followed from company's broad strategy to use acquisitions as a means for growth and diversification into a new market, computer services; C-E-I-R was not specifically identified as a step in the strategic plan.

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16 Hochheiser, *Rohm and Haas*, 98.
Planning: Documentation

The key documents for the planning process are the plans themselves. While many companies have a simple planning process that goes no further than annual operating plans, others may have strategic plans that represent a major commitment of staff time throughout the corporation. In either case the plans may go through several drafts as they are read and commented upon by different individuals. Depending on the scope of the planning, separate departmental plans and divisional plans will be prepared and submitted to the person or committee with overall planning responsibility.

The planning process at any level typically begins with information gathering. If compiled in paper form, this information is placed in a background file that remains with the records of the individual who collected it. Among the documents typically found in a planner’s file are cumulative financial data, sales analyses, budgets, marketing reports, technology forecasts, and published studies of general market conditions. Some of this information may be developed by individual consultants or an outside consulting firm in the form of reports.

Obviously, the prime source of documentation will be found with the authority responsible for overall planning. Company planning committees generate types of documentation typical of meetings and committees in general. These include agendas, correspondence, and minutes. Since the chief executive officer of the corporation is the official with overall responsibility for planning, much documentation of the planning process will be found in the files of the CEO. However, these records are typically scattered among the CEO’s other records.

The ultimate responsibility for the corporation rests not with the CEO but with the board of directors. In practice, corporate boards tend not to be actively involved in making specific policy decisions. However, they are generally asked to discuss and approve major strategic moves. Thus, corporate officers will make presentations to the board on corporate plans and other matters. The official minutes of the meetings of the board of directors record, often in severely edited form, the proceedings of the meetings. These minutes are legally mandated documents that are kept in bound minute books by the corporate secretary. In addition to the official minutes, there are often more detailed drafts of the minutes that can include information that has been edited out of the final documents.

A company may also choose to announce a part of its plan, often in a move to improve its image in the investment community or elsewhere. Companies also make similar public statements for marketing purposes, hoping that by announcing a yet-unavailable product they will interfere with competitor’s sales. Such announcements are significant but inevitably incomplete records of plans. These announcements are generally reported in the trade press. The trade press may also write articles speculating on the plans of companies in the industry.
it is covering. Companies sometimes use part of their annual reports for such planning announcements.

Planning: Additional Observations

Planning is generally considered a central component of corporate activity by senior corporate management. Hence, planning documents are held in high regard within the company and are likely to be saved long after they are obsolete. Moreover, since top management places high value on plans, others within the corporation who have access to all or part of the corporate plans tend to value them beyond their direct usefulness. Thus, even though plans are almost always considered highly confidential and proprietary, it is common to find multiple copies of the plans in a company's stored records. Copies may be held by individuals who put portions of a plan into effect and by those whose positions require an overall picture of the company's direction. Moreover, having access to overall company plans gives an individual a certain amount of status; it is a symbol of corporate trust.

At Control Data, the archives had a master set of operating plans from 1960 to 1970 in the form of eleven thick volumes of approximately 500 pages each. Additional copies of both complete bound volumes and assorted individual sections of plans were found among records of at least a half dozen individuals. The contents and organization of these eleven volumes is typical of plans of that era. Each volume consists of many individual planning documents prepared by the heads of various company departments, both functional (accounting, marketing, international, research and development, etc.) and product or project oriented. The individual reports averaged twenty to thirty pages each.

Companies often produce special non-recurring plans to serve as guide for particular projects or processes. Such was the case in the 1967 acquisition of C-E-I-R, Inc. One of Control Data's first actions after reaching agreement to make the acquisition was to establish a joint task force of managers from both companies' data services divisions to produce a plan for the rapid integration of the two units into a single Control Data division. The task force produced a detailed, sixty-four page report concerning issues such as the relocation of machines, the use of existing personnel, the resolution of pending legal matters, and stock transfer procedures.

It should be emphasized that the use of a structured planning process is the exception rather than the rule for most businesses. Even when formal planning exists, documentation of it may be subverted by personalities that dominate the company. Seymour Cray, the principal designer of both the Control Data 1604 and the 6600 computers, was particularly known for his intolerance of paperwork impinging on his time. One year, the plan for his unit, the Chippewa Laboratory, consisted of two sentences. The first said that the five-year plan was to design and build the world's largest computer, and the second said the one year plan was
to accomplish one-fifth of the above. Such an extreme example is unusual but not unknown in the business world.

While a formal plan may be an obvious record to note for preservation, it is usually an incomplete record of planning. A plan may be completely disregarded; unless care is given to documenting the implementation of the plan after its endorsement, it will be impossible to gauge its effectiveness. Sometimes a formal plan will include procedures for testing its success. A committee might meet on a semi-annual basis to critique and adjust the implementation of the plan. In other cases, it may not be possible for planning documents alone to give an accurate and complete picture of corporate activity. The Control Data Education Company (a division of Control Data) consisted of several operating units, including several concerned with different aspects of the PLATO computer-based education system. The division's plan outlined guidelines for the company's efforts in establishing PLATO, but the plan itself did not indicate the degree of the CEO's involvement in encouraging the development of the product. William Norris, the corporation's CEO, had made the development of PLATO a personal goal, a fact well-documented in numerous speeches he made outside the company. There was much internal evidence of Norris's involvement in setting PLATO strategy, including minutes and presentations for PLATO planning meetings that he attended.

For this reason, archivists and historians should be wary of placing too much value on formal plans alone. On the other hand, it is easy to be overwhelmed by background records, particularly when managing the records of a planning department. A large corporate planning department will have processed a substantial amount of data in any planning exercise. As with all background or reference documents, mere existence does not imply use. A better picture of the development of plans may be obtained from a series of planning drafts, though it is rare in the days of word processing to find a progressive series of reports that depict the evolution of the final form.

The increasing use of the computer by businesses has led to greater sophistication in planning, but has caused more problems for archivists and historians. Data manipulation and computer modeling, which has become a standard element in the planning process, became an important part of computer-based management information systems (or MIS) departments established in the mid-1960s. In the 1980s, much of this work has moved from centralized mainframe-based MIS departments to individuals working within company units on smaller computers or terminals. The development of personal computers and local area networks has made it possible for individuals to do much of this work in their own offices. Unfortunately, it also makes documentation more difficult. While an MIS department at least centralized this data processing, today it is largely decentralized and, from the perspective of anyone wishing to preserve such data, uncontrolled. Both microcomputer and mainframe environments present problems in data preservation. In either case, it is often difficult to determine the source of a collection of data or for what purpose it was used. Central MIS systems are more likely to have documented and accessible "archive files," but later use is problematic both in terms of
reading machine-readable records in obsolete forms and in deciphering the contents once they have been printed or otherwise displayed. If the provenance of the data can be ascertained and the data have historical value, archivists should attempt to preserve this information.
2. Basic Research

High-technology industrial products usually begin in planning, marketing, and research and development, but they may have their roots in basic research. In the industrial context, basic research, also known as fundamental or pioneering research, is that segment of research whose aim is advancing the state of scientific knowledge, rather than applying known scientific knowledge directly to areas of interest in a company's present or planned product lines. This latter function is called applied research. Both types of research are distinguished from development, which involves the taking of the fruits of research or other knowledge and applying them towards commercially useful product. In this section we will consider only basic research; applied research and development efforts are discussed later.

The discussion of basic research has been separated from research and development for several reasons. Basic research is the portion of industrial activity that most closely parallels scientific research in universities and government laboratories. The practice of science, especially in the academic setting, has been the subject of hundreds of studies by historians
and at least two archival guides. In recent years, a number of historians of science have turned their attention to the practice of fundamental science in the industrial setting. Generally, they have set basic research off from other research and development activities and sought at least in part to explain the relationship between this activity, other research and development activities, and other corporate functions.

Basic research is frequently, but far from always, a part of the high-technology industry. Sometimes a company obtains the theoretical information it requires elsewhere, perhaps from outside researchers, published scientific literature, consultants under retainer, or through the involvement of employees with government and other public sector research programs. Often, the knowledge that researchers bring with them to their jobs is sufficient. But in other cases, work proceeds from autonomous technological knowledge. Many, if not most companies, have followed these alternate routes and achieved extended success in high-technology pursuits with no discernible program of fundamental research. A recent example of this is the development of microcomputers that are compatible with the IBM Personal Computer.

When basic research occurs in the industrial setting, it typically does so within a company's research and development division. If the division is large enough, basic research is usually conducted in its own laboratory, or even in separate facilities, like AT&T's Murray Hill facility. The location may be a matter of corporate style. Du Pont first established a fundamental research program in 1927 within the Central Chemical Department, its research and development unit. Initially, this group was separated from existing laboratories in a new building, which became known as Purity Hall. A decade later, after the death of Wallace Carothers, the company's chief research scientist, the company reversed itself and ceased the

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practice of having separate research group with assignments in basic research. Instead, it integrated basic research into the mission of all of its laboratory groups.20

The process of industrial basic research begins with the decision that increased scientific knowledge in a specific area is needed for company progress and that the knowledge will be more valuable to the company if it is internally developed and thus amenable to company control. In such cases, management may authorize a basic research project for one of several reasons. A company may conclude that products could be improved if underlying principles behind them were better understood. This is sometimes combined with realization that relevant work is not being done elsewhere. Such was the rationale for Du Pont's move into basic research in 1927 and its selection of the field of polymer chemistry as a major focus of that research. Polymers already formed the basis of major Du Pont products such as rayon, but study of polymer chemistry was apparently falling between the cracks of standard chemical subdisciplines.21 Research management may also recognize that the company's current technology is too limited for future needs. Mervin Kelly of AT&T realized in the 1930s that vacuum tube and relay technology had inherent limitations that would restrict the continued technological growth of the telephone system. This led Bell Labs to establish a fundamental research program in solid-state quantum physics. AT&T hoped that better understanding of this new area of science would lead to useful solid-state switching and amplification applications. The decision in this case proved a wise one. The fundamental research program led directly to the 1947 invention of the transistor by Bell Laboratories' scientists William Shockley, John Bardeen, and Walter Brattain.22 At times, a research project may originate with a company scientist if the company has enough faith in the scientist's abilities and understanding of company needs.

Once a project has been authorized and funded by management, the research process itself proceeds in a way similar to research undertaken outside of industry. Scientists plan, organize, and perform experiments. The experiments themselves may be physical manipulations, or they may be theoretical "thought experiments" performed mentally, with paper and pencil, or on a computer. Scientists analyze data collected from these experiments and elsewhere. On the basis of their results, they design further experiments and produce new theoretical insights. Eventually, if the project is successful, scientists reach conclusions based on their work and move on to other, perhaps related, research projects.

There are characteristics peculiar to industrial basic research. Industrial scientists work with junior scientists and technicians rather than postdoctoral assistants and graduate students.


22 Hoddeson, "Point-contact transistor," 45.
This often provides increased staff stability. The authorities to be satisfied are corporate managers, rather than one's peers or external funding agencies like the National Science Foundation. As successful corporate managers are ultimately concerned with producing a profit, the success of a research program is typically judged not only by its quality as science or the new knowledge it creates, but also by the degree to which the research results can be applied towards the company's products and production processes. Companies have been known to sponsor basic research projects for reasons of corporate prestige and public relations, in addition to direct technical benefit. But the aim of corporate basic research in general is not just knowledge but knowledge that can be developed into profitable products.

Some companies permit the publication of results in order to foster an academic environment, increase prestige, improve customer relations, and develop staff. Because the desired end result is profit, and knowledge is seen as the means rather than the end, corporate basic research sometimes produces only internal reports, proprietary data, or reports to customers. The successful industrial researcher knows that he or she works for a business and that the ultimate goal of the business is to make a profit, not simply to increase the world's storehouse of knowledge or do good. Ultimately, corporate-sponsored research work must yield practical applications, or the study will be abandoned. One of the hardest tasks faced by industrial research management is to determine the relationship of research to product.

The task may be exacerbated by the different perspectives that scientists and management may hold about the goal and value of the research. To Elmer Bolton, who became head of Du Pont's central research and development in 1930, fundamental research had to be justified in terms of the products to which it led. The discoveries of neoprene and nylon were what made Wallace Carothers' work worth supporting, and Bolton repeatedly pushed Carothers to focus his work in this direction. To Carothers, the practical results were useful by-products; the contributions he made to chemical science, such as his demonstration that polymers were held together by the same chemical bonds as smaller molecules, gave his work value.  

Because theoretical science is not product-directed and is often abstruse, it can be difficult for an outsider to detect the reasons why a company chooses to invest in a particular research program. IBM's long standing program in quantum chemistry has no obvious connection to the company's product areas. Sometimes the relationship of other areas of basic research to company products is easier to see. Since the development and adoption of the transistor, much of computer and communications hardware has been based on the movement of electrons through transistors and other solid-state devices. One might well expect that better understanding of the nature of solid-state physics could lead to improved devices and so to improved computers. Accepting this logic, both IBM and AT&T have long-standing fundamental research programs in solid-state physics and solid-state chemistry. The Nobel

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Prize winning work on superconductivity by J. Georg Bednorz and K. Alex Müller of IBM's Zurich Research Laboratory is a good example of basic research in the computer industry. Information is transferred in computers by moving electrons; superconductivity offers the promise of vastly increased speeds and efficiencies. As of 1988, there is no certainty that advances in superconductivity theory will have direct application to IBM computers, but it is clear why management thinks the research program is worth the investment.

Basic Research: Documentation

The decision to undertake a basic research project is documented in one of several ways. It may originate in a proposal or memorandum written by a researcher to a research director, or by a research director to senior corporate management. The latter is more common if the program is large and expensive or represents a radical departure for the company. The proposal may then be considered by a committee, whose deliberations may be recorded in minutes, and be communicated back to the originator in memoranda. Alternatively, a single manager may make the decision.

Industrial scientists, like their government and academic colleagues, vary widely in the degree to which they work out their thoughts on paper; they may produce research notes or work on problems in their heads, in informal conversation with colleagues, on blackboards, or on computers. Even when they record their ideas on paper, the form may vary widely from miscellaneous scraps to carefully ordered loose leaf or bound notebooks or lab books. Computer-based work may be saved, but often only in a machine-readable form that sometimes outlasts machines capable of reading it. Observational data may similarly be recorded manually in notebooks, or automatically recorded by computers or other machines, such as plotters, that are wired into the experimental apparatus.

Companies, concerned with their patents rights, often require that industrial researchers record and date their work regularly in bound lab books; this documentation is necessary for patent prosecution. The research scientist, or at least the scientist in charge of a research group, is expected by his superiors to produce periodic reports, summarizing the work being done. These reports frequently include both scientific and budgetary information and often have wide internal circulation. If the company research organization is so organized, the individual periodic reports will be supplemented by annual laboratory reports, which will summarize the progress of several related projects taking place in one laboratory. These documents are generally available for internal use only, unlike academic periodic reports which may be accessible to a wider audience. Memoranda and special reports may be produced to report specific difficulties or achievements.

Like his government and academic peers, the industrial researcher may produce correspondence to communicate with other scientists. However, as with all documents sent outside the corporation, the candor of such correspondence may be circumscribed by
corporate requirements to protect proprietary information. Large corporations may have 
staffs of scientists of sufficient size to form an autonomous scientific community. The 
members of this internal community may be located at widely separated laboratories. This 
may lead to a substantial amount of internal memoranda among the company scientists. 
Electronic mail is common within corporations and, in certain cases, may have largely 
supplanted paper communications.

A large industrial research operation makes provisions for formal dissemination of corporate 
research results within the company. Private papers and scientific or technical reports are 
written for internal distribution, and conferences of company researchers working in a 
particular area also may be held, yielding agendas before and proceedings afterwards. 
Sometimes preliminary papers, often called preprints, are circulated before the meeting. 
Reprints and tear-outs may be provided following publication.

Many companies provide an academic-like setting for basic research groups. Seminars on 
pertinent topics may be held by company or guest scientists, and these may be recorded on 
videotapes, audio tapes, or other formats. Researchers may be urged to publish the results 
of their work in scholarly journals and even to publish entire books. Such publications are 
valuable documents, though they may provide a less complete record of results than internal 
documents. Some companies publish their own scholarly journals.

Basic Research: Additional Observations

Successful high-technology companies may or may not engage in basic research. When they 
do, it may be on a selective basis or for only a part of their history. It is important for 
archivists and historians to recognize when a company is involved in basic research, because 
the records are of a different nature than most business records. They do not follow the same 
path as records in other business functions, and the documentation of basic research is not 
likely to be found outside the research department. Nowhere else in business will records be 
found that more closely resemble the records of an academic environment or government 
laboratory.

Research proposals typically give a rationale for why corporate management should undertake 
a given project, perhaps in terms of the product area that will be enhanced by increased 
fundamental understanding. But the results of the project, even if successful in corporate 
terms, is sometimes quite unanticipated. The 3-M company sponsored a research program 
into the chemistry of adhesives in the hopes that increased understanding would lead to 
development of stronger adhesives. Instead, it led to a chemical with novel but weak adhesive 
properties, which the company had the creativity to recognize and then exploit as the well-
known product, Post-it Notes™.
Historians studying academic and some government scientists most commonly use scientific publications as a major source of historical information. Such publications are not an ideal source; they describe results and, at best, rationally reconstruct the process by which those results were obtained. The limitations are even greater in the study of industrial scientists, where the free exchange of knowledge is subsidiary to corporate interest in protecting proprietary knowledge. While research ultimately may be published in scientific journals, this practice is not universal in the corporate world nor is it the primary intended result of the research. General Electric's famous physical chemist, Irving Langmuir, published a large number of scientific papers over the course of his long career, an activity that was encouraged by research director Willis Whitney. But he routinely delayed publication until products or processes derived from his research won the protection of patents. Conversely, IBM adopted a policy of publishing patent disclosures of new research so the research would be in the public domain, thus other companies would not be able to claim a patent. Journals published by companies may contain good work, but they are often published for public relations value as well; their articles have the same reservations concerning proprietary information that hold for all outside publications. In any case, published literature, including scientific journals, is often saved by corporate and public research libraries, so it may not be an essential component of an archival collection, unless the publication is rare or obscure.

The relative historical value of the several types of documents produced in the research function varies both from scientist to scientist and from company to company. For example, Du Pont's Wallace Carothers created a full range of documentation -- lab books, quarterly reports, memoranda, correspondence, and publications -- in the course of his ten years' conducting fundamental research at the company. A historian who studied these records characterized the lab books as too detailed to be of much use in studying Carothers. The same historian found the quarterly reports too circumscribed to allow reconstruction of Carothers' research progress; at the time, the reports were widely circulated within Du Pont, and this made it politically unwise for a researcher to report anything but steady progress. The most valuable documents proved to be the memoranda which Carothers wrote to his supervisors, the directors of the Central Chemical Department. As he was writing to a limited audience, here Carothers allowed himself full written expression of his thoughts, something not found in his lab books, and candor in expressing his frustrations, something not found in his periodic reports.

Indeed, the archival value of lab books is often less than is normally assumed. Some researchers adopt the attitude that keeping these lab books is an external intrusion on time that could be more usefully spent doing research. Therefore they record just enough information to satisfy the demands of others, thus reducing the value of lab books as a detailed chronicle of their day-to-day work. Other scientists use their lab books to record

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raw, unanalyzed data of experimental runs. Still others use the lab books to record results and thoughts in great detail. Some even use them as professional diaries, and chronicle their impressions of conversations and meetings. Therefore, examination of a scientist's lab books or knowledge of his or her work habits is necessary to determine the archival value of a particular collection of lab books. Lab books are taken seriously by research management, who carefully number and store them for years after the completion of the research in the belief that they will enable the company later to trace the evolution of a research project, as might be needed in a patent interference case.
3. Research and Development

Research and development is the most distinguishing function of high-technology industrial activity. It is in seeking and exploiting technological innovation that high-technology companies make their mark. Conceptually, research and development can be subdivided into three successive substages: basic research, applied research, and development. In actual practice the lines between these substages can blur, so that the industrial research and development process approaches a continuum of activities with research at one end (providing the process begins with research) and a new product for distribution at the other.

Applied research may be defined as the application of known scientific or engineering principles to areas of general interest to a company's present or planned product lines. Often, it is not directed towards a particular product but towards a broader goal such as producing improved technologies that can underlie a range of company products or services. Applied research differs from basic research in that it is not focused on the advancement of scientific knowledge but on the application of existing knowledge. An applied research project may
flow directly from a basic research effort. A number of applied research projects at Bell Labs and elsewhere followed from the invention of the transistor in late 1947. By the time the first transistor was announced, the Bell Labs group had worked out the necessary scientific principles of solid-state quantum physics. But the actual construction of working transistors in more than laboratory quantities required additional applied research in other areas. New techniques were needed to produce silicon and germanium crystals of extremely high purity and then to dope these crystals with carefully measured and distributed impurities. Another path pursued at Bell Labs was to use its theoretical scientific understanding to develop improved types of transistors, such as William Shockley's junction transistor. Still further afield, Bell Lab's scientists investigated related phenomena predicted by the theory. Notable among these projects was David White's work showing that under appropriate conditions semiconductors could be devised which gave off visible light, a phenomena which led to the development of light-emitting diodes.²⁵

Applied research also can be the starting point of an industrial research project. In this case the process will begin with a decision by the research department or company management to develop knowledge of scientific or technological principles for further use by the company. Around 1920, advances in automobile engine design and petroleum refining were working at cross purposes. Designers of advanced engines discovered that they could increase both efficiency and power by increasing the compression ratios of their engines, but such engines required more highly refined gasolines to avoid the well-known but little understood phenomenon of "knocking." Refiners, in order to keep up with the rapidly increasing demand for gasoline, developed methods to extract greater quantities of gasoline from each barrel of crude oil, but at the price of lowered quality. To try to reconcile this dilemma, Charles Kettering, director of the General Motors Research Laboratory, assigned one of his engineers, Thomas Midgely, to work with him to uncover the causes of knocking. Kettering was convinced that the problem was in the fuel, not the engine. By studying the behavior of various gasolines in test engines devised for the purpose, they soon reached the conclusion that the knocking was caused by delayed combustion of some of the fuel, and he theorized that this was related to the lower volatility of the poorer grades of gasoline. The applied research led to the development of Ethyl gasoline.²⁶

Development generally follows directly upon successful applied research. Development aims to produce a finished, saleable prototype, ready for marketing and production. Typically,


development is divided into two steps: advanced development and product development. Advanced development is concerned with proving the feasibility and practicality of the results of applied research, and product development with using these results to design, develop, and produce a marketable product. Development work may continue after a product is introduced into the marketplace. When this work is performed in response to the market reaction to the product, it is called product enhancement and is discussed in a separate section.

Often advanced development proceeds seamlessly under the direction of the same researchers as did the applied research. Such was the case with Kettering and Midgely's work on engine knocking. Convinced that fuel volatility was the key problem, Kettering hypothesized that the answer could be found in additives that would increase the volatility of the fuel. Midgely and Thomas Boyd proceeded to try a variety of substances as additives to test their hypothesis. Boyd found that the dye intermediate, aniline, possessed the proper characteristics. It proved, however, to be impractical for actual use, it was too expensive and in too short supply. Nonetheless, the laboratory success with aniline convinced the men that they were on the right track, and they persisted until in December 1921 they found a more suitable additive, tetraethyl lead (TEL).

The scope of product development is broader than that of the other substages of research and development. Basic research, applied research, and advanced development are functions performed within the research and development laboratory. Because the objective of product development is a commercially viable product, product developers work far more closely with other corporate operations than do researchers working earlier in the research and development process. Product developers work with production to design a product amenable to manufacture in commercial quantities, assist in the selection of production scale parts and processes, and help design the production line. They work with marketing departments to assist in product and market definition.

The example from General Motors also illustrates product development. Kettering and his team discovered that addition of a second additive would prevent TEL from leaving lead deposits in the engine. They determined the optimum proportion of TEL to produce gasoline with the desired characteristics and investigated industrial scale syntheses for TEL. Kettering sent out samples to oil companies and invited discussion. Since GM was not in the chemical business, Kettering contracted with Du Pont for the actual production of TEL and had his team build a pilot plant at the GM Research Division facility in Dayton, Ohio to blend the TEL into gasoline. It took over two years of product development to reach test marketing. In 1924 General Motors set up a joint venture with Standard Oil of New Jersey to manufacture TEL. It took a number of years to convince various industry members, including the heads of the several GM divisions, that Ethyl gasoline was a solid improvement and that production engines should be redesigned with higher compression ratios to take advantage of the new fuel's better combustibility. Thus one product development begets another.
So far, the substages of research and development have been described as distinct and independent on a practical as well as a conceptual level. In reality, it is often difficult to distinguish the substages. Even where the substages are conceptually separable, as with the development of Ethyl gasoline, they may not have been so in the minds and practice of the participants. This merging of substages into a less differentiated whole is particularly common in cases where the successive activities were carried out by the same individuals. It is highly unlikely that Kettering and Midgely saw their work as three separate but related projects.

Not only is it sometimes difficult to divide industrial research into the three substages, but the actual history of a given industrial research project may be more complex than a neat progression of conceptual stages. A project may be aborted at any step along the way. Projects may completely omit one or two of the substages. Advanced development may be based on external or previously performed applied research. Product development may proceed directly from the desire to improve an existing or acquired product. Both types of development may originate from a suggestion from marketing for a saleable product.

An industrial research project may begin with either of the development steps, or with work done elsewhere serving in place of the research substages. Control Data's 1973 decision to invest heavily in computer-based education, for example, was predicated on its ability to acquire rights from the University of Illinois to the already operable computer-based education system known as PLATO. The corporate officers who made the decision to develop PLATO as a product knew that it was inadequate from a commercial standpoint. Thus, the company began a multifaceted development effort. Included were modification of the system software to enhance its record-keeping ability; design and introduction of techniques to allow a single Control Data mainframe to simultaneously run both the PLATO system software and the general-purpose NOS operating system; the development of large quantities of new courseware, much of it for non-academic purposes such as industrial training; and the design and production of a new, less expensive terminal than the one in use at Illinois.

Product development does not lead to production in the case of custom or one-of-a-kind products. The Clip-Pin project, a massive computer system built around a Control Data 1604 computer, is a good example of this. Here the prototype, once tested, was the final product that was shipped to the customer. Like many such projects, Clip-Pin was developed to fill a government research and development contract, in this case a contract won by Control Data from the National Security Agency. One-of-a-kind products are also the backbone of many high technology service industries, such as custom software firms.

The progression of steps from basic research, to applied research, advanced development, and product development may seem at first glance to be equivalent to a straightforward progression from science to technology, but the reality is far more complex. The relationship between scientific research and technological development is interactive. In the corporate
context, the line between the two can become indistinct and approach a single new entity known as industrial research. In carrying a R&D project to completion, a single researcher may engage in activities understood both as scientific (seeking new knowledge) and technological (making new things), and it may be impossible to tell from the pattern of work whether the researcher's background is science or engineering. Moreover, one step can loop backwards to a previous one, all within the work of a single individual or project.

The development of magnetic drum memory at Engineering Research Associates between 1946 and 1949 is a good example of the interplay of science and technology in industrial research. The complexity of this research and development project led to its division into parallel efforts by several separate teams of researchers. Physicist Sidney Rubens led the team assigned to develop a suitable read-write head. Essentially, Rubens's team worked to adapt German magnetic tape recording technology captured in World War II into a device capable of recording and playing back digital information for use in a computer system. Yet, much of the effort went not to technical design but to scientific study of the magnetic properties of various materials that might be used for recording heads. While in retrospect we can point to components of the project and say "this piece is science" and "this piece is technology," to Rubens they were all part of a single whole, a successful industrial research effort.

Research and Development: Documentation

Applied research and advanced development are laboratory processes formally akin to basic research, and the documentation for these substages follows closely on the pattern already described in the basic research section. Therefore, it is often difficult to determine to which substage a piece of industrial research belongs solely on the basis of types of documentation rather than content. From an archival standpoint, it may not matter. As with basic research, one should look for proposals, research notes, notebooks, lab books, reports, annual laboratory reports, correspondence, memoranda, conference agendas and proceedings, and published articles and monographs. Development is more likely than research to lead to patents, which are discussed later.

In product development, a number of additional documents are created. These record the extensive interactions of the product developers with other corporate operations. Thus, there will be a program plan written at the commencement of a specific product development project. This is a general document, typically approved and signed by representatives from development, production, and marketing. It gives a description of the desired product and why it is needed, assigns responsibilities for different portions of the work that needs to be

27 Reich, Industrial Research, 206-217.

done to get there, and outlines budgets and time schedules for the work. As it is an interdepartmental document, it is likely to be more detailed than any plan produced to govern other research and development work. The lead product developer produces a set of design requirements, outlining in technical terms what the product should do. These requirements may be changed as the work progresses, but then requirement revisions are issued. When the product development team completes its work, it prepares a set of product designs, alternatively known as product specifications. These are detailed descriptions of the product: how it is to be put together, what it does, how it should perform, allowable tolerances, and the like. Production engineers often contribute to the writing of these specifications. The product specifications are then used in many other parts of the industrial process: by production as the guidelines for manufacturing the product, by field engineering for trouble shooting and maintenance, by product enhancement as the starting point for product improvement, and by development in the design of compatible products to work with the ones under consideration. Such specifications are the central technical document for a product. Several of the documents discussed in the production section may be the joint work of product development and production; examples are lists and specifications for production equipment and parts. Also, internal bulletins and notices may be sent to particular company audiences, like sales representatives.

Research and Development: Additional Observations

Research and development are not only central to successful performance in high-technology industries, they tend to be central to the company's image as well. Du Pont's corporate slogan for many decades was "better living through chemistry," not "better living through profits." In addition, the fruits of past company research and development activities are considered, especially by research management, as major company assets that can be called on in the future for sometimes unanticipated purposes. Hence, research and development records are considered important by high-technology corporations and are more likely to be preserved until there is absolutely no perceived need for documents. Research reports are rarely destroyed, though correspondence and program summaries may be discarded after they are no longer perceived to be of current value. As it is the research division that holds these records in highest regard, the records are often (but not always) preserved within the research and development division, independently from corporate records management.

At the Rohm and Haas Company, every report written by a research division employee, going back to the those of the first full-time research scientist the company hired in 1924, are kept in a well-indexed microfilm collection at the research division library. AT&T manages and stores the records of Bell Labs separately from those of its business activities. Only recently has AT&T combined its historical archives for research and development with those for other corporate activities. This was done in large part as a result of reorganization following divestiture. In contrast, research and development records at Du Pont were managed as part of the general corporate records management program. Only lower-level research and
development records, such as lab books classified as technical, were given long retention periods. Research and development reports were classified as managerial documents and retained for only a few years. Some companies do not seem to consistently follow either pattern. At Control Data, a literature room at its research and development facility had an extensive set of development documents, but other R&D records, such as lab books, a large run of project progress reports for the years 1959-1964, and boxes of files from abandoned projects, were found in the company's main storage center.

The comments made in the section on basic research about the relative value of the types of documents applies equally well for research and development documents. While Wallace Carothers' lab books proved too detailed to be useful by a scholar studying Carothers's career, Seymour Cray's notebook for 1957-1958, the years when he was designing first a novel circuit and then the Control Data 1604 computer, proved too terse. All but twenty-one pages of the book are blank. The writing is neat, in full sentences. Sometimes as little as one sentence appears for a single date in an entire month. On a few occasions, the sentences are supplemented by neat tables of data. This lab book was obviously written for others to see, rather than for any use by Cray himself and therefore has limited value in documenting the development of the 1604. Another scholar, working on the career of Charles Kettering, found Kettering's correspondence and memoranda to be of the highest historical value, especially the numerous memoranda between GM research director Kettering and GM president Alfred Sloan.29

When an industrial research project is based on work done elsewhere, or done in collaboration with outside workers, it is often possible to document the process from records held by these external participants. This was true in the case of the development of the PLATO computer-based education system. The research, development, and existing uses of the University of Illinois PLATO system was the starting point for Control Data's development efforts. The company made the decision that the plasma screen display terminals were inadequate for commercial purposes and gave its peripheral products group the task of developing a cheaper, more reliable terminal for PLATO. The IST terminal product development team that was formed at Control Data worked closely with Jack Stifile, the University of Illinois designer of the earlier terminal. Stifile had retained a thick folder of substantive correspondence with the Control Data developers, correspondence that by itself would allow a researcher to reconstruct much of the IST terminal development process. In addition, Stifile had copies of Control Data's specifications for the new terminal.

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4. Production

Unless the goal is building a one-of-a-kind, special-purpose product, industrial activity eventually moves from development into production, where salable quantities of the product are produced. Also referred to in industry as "operations," production can be divided into two activities: periodic and continual. Periodic production involves the initial establishment or start-up of production: space is allocated, a work-force gathered and trained, special-purpose tools ordered or designed, procedures developed, materials selected and ordered, guidelines written, and quality assurance and control procedures devised to ensure that products meet the design specification. Continual production is concerned with the maintenance of production by adjusting work force levels, inventory, production schedules, and processes in order to meet planned output and assure quality control.

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Production is often thought of in terms of mass production: the manufacture of large quantities of a product, be they automobiles or drugs. Production may equally well refer to smaller quantities. In all, Control Data made sixty-one computers in the successful 1604 product line, each one hand-built by a team of engineers over a period of several months. The teams were building essentially identical machines to a predetermined design, and sixty-one was a substantial run for a large computer of its generation. Aircraft, submarines, some medical diagnostic equipment, certain luxury cars, and other high-capital goods follow similar small-scale production patterns.

Production involves all products that are expected to be sold in quantity. Though custom-built, one-of-a-kind products are likely to make use of production techniques (such as wiring a computer) or production staff, this activity is a function of development. Products that will not be replicated usually remain in the jurisdiction of research and development departments. A product may serve as a prototype of a production model and still be within the realm of development activity. Thus the Whirlwind computer was regarded a developmental activity, even though it served as the prototype of the SAGE computer. One high-technology area in which the boundary between development and production is particularly confining in recent years is computer software. This is true because of the pervasive discussion by software developers about the "production" of software. Currently, "software production" actually refers to development; in our context the production of programs occurs as the programs and program documentation are replicated, much as a compact disk of a musical recording is reproduced. This may not be true in the future because of the effort to make software more modular and thus conducive to production techniques.

Among high-technology companies, there are important distinctions between modes of production. In the chemical, pharmaceutical, and semiconductor industries, a key distinction is drawn between batch and continuous processes. In the former, the production is divided into distinct lots, each of which is produced separately. The quantity produced per lot is determined either by the capacity of the equipment or by marketing requirements. In continuous production the product flow is constant. Small-scale production in the chemical industry is almost always a batch process. Large-scale production may be either, depending on the nature of the particular reaction. Since continuous processes tend to be more cost-efficient, there is a constant drive in these industries to replace batch processes with continuous ones.

Most "periodic production" is initiated at the end of research and development, or when manufacturing rights are acquired through license or purchase. As a product is developed, the elements required for its manufacture, such as raw materials, manufacturing methods, and quantities, are defined. All production requires some level of planning, often conducted by

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a manufacturing engineer. Planning for a large production is likely to be divided into component parts on the basis of facilities, materials, inventory, scheduling, quality control, physical layout, and staffing. Very often a complex production job is divided among a number of facilities. Components may be sub-contracted from other manufacturers, as is often the case with engines or computer systems in aircraft.

Operations research models may be used during the development of a production system in order to project the manufacturing time based on variable factors such as flow of materials and time per task. Two common planning tools often employed by business and government are Program Evaluation and Review Technique (PERT) and Critical Path Method (CPM), both developed during the 1950s to manage the development of large production jobs. Variations of PERT and CPM have been developed over the years and have been adapted for use on the computer.

The start-up of a production system is also part of periodic production. It is common to have a limited test production run (sometimes known as "pre-production") to locate unforeseen problems. This is only practical when products will be produced in high quantity or when costs are relatively low. Control Data's PLATO IST terminal, which was a relatively inexpensive product, had a pre-production run of ten units. Durable goods are often used in-house for further testing ("alpha testing"), or tested outside the company ("beta site testing"). If major problems are encountered, the product is modified. Otherwise, full production will commence. There is likely to be a period of troubleshooting for tasks that are not performed as expected and also of training for employees who will maintain production.

While periodic production focuses on the start-up of production, continual production is concerned with maintaining the system in order to deliver goods in a timely fashion as efficiently as possible. Here, production management is concerned with monitoring the system and adjusting it when it does not perform well. Raw materials and components must be supplied at an adequate level and quality, and final goods must be produced on schedule with minimal waste. Related activities involve material procurement, sub-contracting, personnel, and periodic reporting.

Quality control is a critical factor of continual production. In the manufacture of a complex machine, at least a representative sample of the components purchased or made for incorporation into the finished machine is tested for conformance to specifications. The tests may be sophisticated or simple; one simple test of the physical stability of transistors for 1604 circuits was to toss a sample up to the ceiling and see whether they broke on landing on the floor. Additional quality control work may occur at intermediate points during production; the likelihood of this increases with the complexity of the device being produced, the criticality of high precision and reliability, and the amount of competition in that industry. The amount of intermediate testing may also be the result of management style or preference. Testing is usually performed at the end of the production process. In mass production, only a small sample may be subjected to extensive testing, employing statistical techniques to
maintain production line quality. In small-scale production, every machine is likely to be subjected to a large battery of tests. In the manufacture of the early computers, the "debugging" of the machine after initial assembly could easily consume half of the total production time. In the case of the first UNIVAC computer, logic or circuit errors were commonplace, often necessitating immediate design changes.\(^{32}\)

While quality control procedures need not always be as formidable as they were with the UNIVAC, they are required in some form. Testing ensures that established standards are met. Thus, chemical companies have analytical laboratories attached to their factories, where product samples are tested for strength and purity. Typically, a chemical company has more personnel working in these laboratories than in research. Standardization may well be a critical selling point for a chemical product; such is almost always the case with pharmaceuticals. It is probably also true to a certain degree in the production of electronic components -- but less so for radio components than for computer components.

Because it is impossible to anticipate all of the problems that can develop in production (especially when one is at the leading edge of technology), procedures for trouble shooting and modifying the process or product are built into the production system. Changes may result from an ongoing product improvement program or from customer feedback. The modifications may be produced by the product support and enhancement group or by a laboratory attached to the production department. In the case of the production of computers and other electronics, "engineering change orders" are issued to fix newly uncovered problems. In the chemical industry entire production laboratories are charged with eliminating the "kinks" in an ongoing process. During World War II, Rohm and Haas struggled to keep up with the military demand for its new product, Plexiglas acrylic sheet (which was used widely in the transparent portions of aircraft). While a manufacturing process had been worked out in the late 1930s, it was not well understood, and a team of chemists had the critical responsibility of solving quality problems in the output and keeping the production flowing to meet war needs.

When goods are finished, they are transferred from the production department to a traffic department, which is in charge of either warehousing the goods until they are sold, or shipping them to distributors or customers.

**Production: Documentation**

The documentation for production is best considered in terms of the two separate sub-stages of production, periodic production and continual production. There are many similarities in documentation for the two sub-stages, but the documentation is not identical.

\(^{32}\) Herman Lukoff, *From Dits to Bits* (Portland, Ore: Robotics Press, 1979), 98.
1. Periodic Production

The production process for a new high-technology product begins with the transfer of the product from the development department to a production unit. This in turn requires the transfer of knowledge about the product, which customarily takes the form of product designs or plans. These describe the product, how to make it, and what it should do. The last of these is also referred to as product specifications. A production process is frequently broken down into a series of successive or parallel steps, each of which will have its own documentation. The plans may take the form of written instructions or, as with electronic goods, technical documents such as schematics, wiring diagrams, and diagnostic routines. These more technical documents may prove too technical for the archivist or historian to decipher adequately without expert assistance. Sometimes, the transfer does not generate much documentation, especially when the transfer is implemented by hands-on instruction or by one or more individuals moving with the product from development to production.

With small-scale production, the design of the production space is usually of little import and may be undocumented. But in mass production the design and assignment of the space may be crucial and the result of considerable effort. If so, it is recorded in floor plans, similar in character to the product designs themselves. These include schematics for floor layout, showing both the positions of the various machines used in the production and the flow of the production line from start to finish. These plans also give personnel requirements and distribution for each step in the production process.

Related documents include lists and specifications of equipment needed to manufacture the product. The equipment varies greatly in its sophistication from complex, specially designed machine tools (in which case its documentation is important to understanding the production process) to sophisticated items of standard outside manufacture (in which case its documentation is of lesser value), to simple tools like screwdrivers. Specially designed equipment has its own set of documentation describing its design, operation, and maintenance. Such equipment is likely the result of a significant research and development effort itself and thus is documented like any other research and development project. These lists and specifications are supplemented by purchase orders and correspondence with equipment manufacturers.

Documentation is produced in the procurement of parts and material that are used in manufacturing. There are lists and specifications for needed material, correspondence with potential suppliers, purchase orders, and perhaps test reports, where company scientists or engineers evaluated the goods offered by potential suppliers. Sometimes, a company subcontracts a portion of the production process to another firm. If this is the case, it is documented similarly to procurement, with lists and specifications, test reports, and correspondence.
Still another activity is the hiring and training of personnel. Documentation related to hiring is a component of other personnel records. Material relating to training can be quite voluminous. Most production systems have specific written guidelines for their various procedures, reference manuals for general production steps such as soldering, and change orders to accommodate changes in procedures. Frequently this documentation appears in the form of video tapes, filmstrips, slide shows, and computer-based training systems.

As the production process gears up, the production supervisor periodically writes an internal report to his superiors. These reports may be full and informative or merely pro forma.

2. Continual Production

There are different types of records that document the actual production of goods. The production is controlled by schedules, which give daily, weekly or monthly lists of what is supposed to occur on the production line. They contain data such as quantity to be produced, progress to be made on items that require a lengthy manufacturing time, supplies to be added, and maintenance to be performed. The quantities to be produced are in turn based on sales or on marketing projections produced by other departments and communicated to production using internal memoranda. Schedules are complemented by production logs, bound books, or more recently, computer-generated records in which data about the production system are recorded. The logs contain records of problems as well as production that performed as planned. A production log for a batch process individually documents each batch. In a continuous process, the log records any changes in the conditions, the quantity of raw materials consumed, and the quantity of product produced over time. These schedules and logs are usually too detailed and not aggregated enough to be of high historical value, unless cumulative records are unavailable. The cumulative records most frequently take the form of periodic reports written by production supervisors for their superiors.

An overall description of the production process and all its stages, details, and goals is typically kept in a central production or manufacturing engineering office. It is most frequently known as an operations sheet. This is often the most important single document for documenting an ongoing production process. Operations sheets go through revisions because the production process and the product itself are rarely static over the course of its history, so it is desirable to retain at least the original and some of the later revised versions. There are several sources for these ongoing changes, but in general they are recorded in the form of change orders. The modification is summarized in the production supervisor's periodic report, along with the date it was put into effect.

One function of the production laboratory is quality control. Repeated testing ensures that the product meets its specifications and works as described; the results are recorded in quality control logs. More recently, data from quality control tests have been collected and analyzed by the computer and may never have been converted from machine-readable form.
In both cases logs are usually recondite and of no archival value, although saving a few samples may document the existence and nature of the process.

The transfer of final products is recorded in either *memoranda* or *internal bills of sale*. The reports of individual transfers are typically of lower value than aggregated periodic reports, written by traffic department supervisors for their superiors.

*Photographs, films, and videotapes* of the production process are valuable, though sometimes rare. They often document plant layout and construction techniques far better than written descriptions, which too often fail to capture informal modifications.

**Production: Additional Observations**

Production records are rarely perceived within the corporation as having value past the end of the production run for the particular product, so they are far less likely to be saved as a group than the records of other departments. Sometimes company record-keepers will carefully preserve the firm's very first production log as a memento. While it may well have sentimental value, it is of limited historical use without subsequent logs. Serial number logs for large capital goods, such as aircraft engines, are an exception; they are commonly preserved for non-historical purposes (such as lawsuits involving aircraft failures).

If production involves only simple assembly, the activity is unlikely to be historically significant even if the product itself is historically important. However, where a product is enhanced by a complex or innovative production technique, the technique itself may be quite interesting to historians. Part of Federal Telegraph Company's success in producing oscillator tubes was due to the development of new tube manufacturing processes by Charles V. Litton. Detailed descriptions can be found in the Litton Papers at the Bancroft Library, thus providing insight into the history of early radio tube industry.\(^{33}\) Even with simple devices, such as transistors or magnetic cores, the process for their manufacture may be complex and the critical tolerances small. Thus, the important portion of the history of the manufacture is likely to be the design and development of a production process, rather than the operation of the process once developed. For example, the process for mass producing the millions of magnetic cores needed for the main storage memories for IBM models 704 and 705 computers was one of the critical roadblocks that had to be overcome before the introduction of these computers in 1956.\(^{34}\)

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Documents relating to the early planning stages of production may be uncommonly elusive, particularly when the transition from development to production is gradual and subtle. The production of the 1604 computer was only gradually transferred from the engineering department (i.e. development) to a separate production unit; between six and ten machines were constructed before the transfer was complete, and the transfer was accomplished by moving engineers from development. Hence, the wiring diagrams, logic diagrams, and other records used for development were also used to guide the production of the early machines. Especially in small-scale production of high-technology products, there may be little distinction between development and production. The production of UNIVAC computers involved constant, ad hoc improvements and modifications, ranging from perpetual modifications of the logic design to the introduction of a water cooling system with UNIVAC serial 9. In such cases, the records of production and development originate from the same source.

Production can be partially documented from records found elsewhere in the company. For example, no set of production department records for the 1604 computer were found, but production was documented in a series of production schedules from the marketing department, which had an obvious interest in this information. Marketing had to advise customers when to expect delivery of the machines (each of which took six months to build), and it had to schedule shipping and installation.

Visual records may often represent the sole source of documentation relating to production. The public relations department of General Electric's computer division produced a film entitled "Manufacturing Competence" in the early 1960s. While the film was intended to impress customers with GE's stringent quality control procedures, it shows the production lines for several computer components, highlighting those processes GE believed particularly efficient or innovative. Such records, whatever their original purposes, may document assembly techniques and conditions.

If records about production processes are not found within the company, it is unlikely they can be documented from records produced or held outside of the company, unless the processes were patented. Except for discussions about automating production, it is uncommon to find detailed descriptions of individual production processes in the trade press, as such information is considered proprietary. What is more frequently found are aggregate production figures and announcements of production milestones.

There are several modes of production that differ in both process and documentation. In high-technology industries there are both small-scale production, such as the production of the space shuttle, and large-scale or mass production, as in the manufacture of integrated circuits. In the former, a characteristic quantity measured is time (in days or months) needed to produce a single unit; in the latter, the measurement is units produced per day. Thus small-

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scale production has a series of checkpoints or milestones as the production proceeds, and these will be documented both in the plans and in the periodic reports. Distinct documentation, then, is created for each individual unit, such as each space shuttle or each airplane. In mass production, where the status of individual units is rarely at issue, the periodic reports will concentrate on the aggregate, and problems are likely to be traced to overall problems in the production line.

Quality control procedures may occur at different places in the production process, and the documentation produced varies accordingly. Quality control typically produces reams of documentation, as every single test tends to be recorded. Though the logs are of little enduring value, records of the design of test procedures and statistical summaries of the tests themselves often are useful to historians. At times, feedback from marketing or field engineering informs production of a quality control problem such as an unreliable component. This leads to redesign of quality control procedure and thus new written guidelines.
5. Marketing

Simply stated, marketing attempts to identify wants and needs of consumers and deliver goods or services in the most effective manner possible. It does so through an analysis of market opportunities, selection of markets, development of the "marketing mix," and management of marketing activity. Philip Kotler, professor of marketing at Northwestern University, defines marketing as "human activity directed at satisfying needs and wants through exchange processes."36 Although other definitions emphasize different aspects of marketing, such as distribution or sales, all definitions focus generally on the exchange process. The concept of marketing was not developed until this century, and it is not the sole philosophy guiding business in the exchange of goods or services. It is, however, predominate in business thought today.

When a company looks for "market opportunities," it attempts to find areas where it is likely to have a competitive advantage. This can be done with existing products in two ways. First, a business can take action to secure a larger share of a market. After the introduction of cheaper versions of IBM's Personal Computer by other manufacturers, IBM responded by lowering the price of its own PCs and increasing promotion. This was done in an attempt to protect and expand its share of the market. Second, a company can develop new markets. The Du Pont rubber chemicals division worked for seven years starting in 1930 to develop a market for neoprene among rubber manufacturers before achieving initial commercial success. Neoprene was too expensive to compete with other rubber but was sought after Du Pont emphasized its special qualities to customers who needed an extremely flexible and oil resistant rubber.37

High-technology companies are less likely than businesses in general to rely on these two methods because of the limited life of many of their products. Instead, they may develop new products for existing markets or diversify by introducing new products for new markets. After all, development is at the core of high-technology industry. In 1968 RCA's market research began looking for an innovation of similar scope to color TV in the consumer electronics market. The analysts' surveys indicated that a prerecorded video player ranked highest among several hypothetical innovations presented to consumers. This led to a corporate commitment to develop such a player, along one of several lines that had been suggested by corporate research.38

It is not uncommon for research to lead to new products that are outside the domain of a company's traditional markets. Companies may take advantage of such work by moving into new markets. This was true when Monsanto's research and development department developed the first low-sudsing laundry detergent in 1946. The product did not fit into the existing market of detergent and soap manufacturers because these customers had been educated by Monsanto to equate high suds with effective cleaning. Monsanto, believing it had a winning innovation, decided for the first time in its history to sell a product directly to consumers. All™ detergent was a success, though Monsanto eventually decided that consumer goods were too far from its main business areas and in 1957 sold All™ to one of its customers, Lever Brothers.39 A proposal to pursue a new market is rarely taken lightly; it involves a major strategic redirection and thus typically requires approval from top management.

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The selection of markets is based on prior planning, corporate traditions and style, perceived areas of expertise, and market research. In most cases, the market is one that the company already serves. Senior management may specify the market for a new product as part of overall corporate planning. Thus, the decision by Control Data to market the PLATO computer-based education system to educators was made by CEO William Norris. Thereafter, marketing's role was restricted to understanding how best to satisfy this objective.

Markets may be defined broadly or narrowly. Innovations in consumer electronics may be aimed at all consumers of home entertainment, which is the enormously large group of households with at least moderate income. Throughout its history, RCA saw this as its prime market. It had successively led in this market through its innovations in radio, black-and-white television, 45 RPM records, and color television. A narrower market was the target of IBM's first production computer, the 701; the market consisted of a small group of defense-related engineering and research establishments. Large multi-divisional companies often serve several disparate markets; in addition to consumers, RCA also had divisions in the defense and aerospace industries and, until 1971, the mainframe computer industry.

Market research can be utilized to guide the identification of opportunities, selection of markets, and identification of the proper marketing mix. Individuals performing this work are known as "market analysts." They rely on data obtained from many sources ranging from externally published reports to direct surveys of customers. In a mature modern company, the marketing research process is often extensive and takes place in a market research group or department reporting to the marketing director.

Start-ups and small companies seldom engage in extensive market research. Instead, the target market and product may emerge from an educated guess or hunch. No team of market researchers told Henry Ford that a simple, rugged car priced to attract the masses would satisfy an unmet market need, but he reasoned that it would and came up with the Model T. George Eastman did not rely on surveys to tell him how he could vastly expand the market for his photographic products in 1887 beyond their traditional base of professionals and serious amateurs. Yet, he believed that if he could design a camera that was simple to operate, was inexpensive, and did not require a professional photographer, he could develop a new, large market. This was accomplished with the introduction of the first Kodak camera.

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Once opportunities and markets have been identified, the next step is to develop a product's marketing mix, or the well-known four p's of marketing: product, price, place, and promotion. This information forms the basis of a marketing plan that outlines the way in which the company expects to achieve commercial success with the product or service.

In high technology, the product may already be well-defined by research and development or corporate planning. Even in that case, marketing still has an important role in defining the final product. Issues to be addressed may be as straightforward as determining the color of a new product, or introducing new packaging techniques. Design considerations may originate from the engineering department or marketing. The decision to package the first Osborne microcomputer as a "portable" unit complete with software was a marketing decision (even though it originated from the founder of the company). Products must be "packaged" correctly; the wrong selection of product attributes will significantly affect the success of the product. New packaging can expand markets for a product. United Technologies modified its aircraft engines and sold them as pumps for gasoline pipelines. The "gas goosers," as it was known, was simply one of its aircraft engines packaged for a completely different purpose. Other characteristics like quality control are also a concern of marketing. The emphasis on quality of Kodak and IBM copiers enables the two manufacturers to command higher prices for these products.

Product pricing is a complex art that usually starts with the determination of direct costs of manufacture and distribution. This is not simple, because direct costs for many products vary with volume, and the company must estimate the volume that it is likely to sell. To this must be added amortization of costs incurred in the development of the product, the preparation of plants for production, costs for sales, advertising, and promotional expenses, as well as indirect costs such as corporate overhead and product liability insurance.

Price determination is based on market and competitive conditions as well as costs. A crucial feature of George Eastman's plan for marketing photography to novices was to produce a camera that could be sold, including film, for no more than ten dollars. He believed that a moderate cost was necessary to attract his intended market. Computer peripheral manufacturers in the 1960s and 1970s, seeking to compete with IBM, frequently found it necessary to use IBM's prices as a benchmark. Disk drive companies such as Control Data and Calcomp sought to price their products sufficiently below those of competitive IBM products to give potential customers a sufficient economic reason to forsake the perceived safety of buying from the market leader. At the same time, the drive manufacturers did not want to price their products so low that customers would assume the products were poorly manufactured. Unfortunately, price suggested by evaluation of the marketplace may not correlate well with prices suggested by internal costs. For years, no company seeking to compete directly with IBM in the mainframe computer market was able to turn a profit.  

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Not only does the price of a product itself send out important signals to the marketplace, it may also determine the niches where the product stands a chance for success. Ernest Bridgewater of the Du Pont rubber chemicals division realized early in his exploratory efforts in the 1930s that Du Pont costs for neoprene made it prohibitively expensive compared to the price of natural rubber. Thus, Bridgewater chose to price neoprene on the basis of internal costs, and searched for market niches where neoprene could be sold at premium prices on the basis of its unique characteristics. He found several such niches including telephone wire insulation, where its superior weatherability made it more durable than rubber, and automotive and aviation hoses, where its resistance to degradation from oil and gasoline made it a superior product. He put little effort into using neoprene for tires, the largest use of natural rubber.  

Another element of the "four p's" is place, which specifies where the product will be distributed. Often distribution is determined by the company's existing channels and the nature of the product and its market. Goods are distributed directly from the company to users when there are relatively few users and the individual transactions are large, such as with computers, jets, many specialty chemicals, or other technically complex goods. Large capital goods, such as mainframe computers, are often produced only after orders are received, rather than being produced for inventory and warehoused. Where there are many users for a product and the individual transactions are small (as for consumer goods), the distribution channels tend to be indirect. The company works through multi-layer distribution systems involving regional warehouses, independent distributors, and retail dealers. There are also various intermediate patterns between these two extremes. Sometimes companies establish multiple distribution channels to serve different parts of a market. Thus, at one point, IBM distributed its personal computers directly to large corporate users and established retail stores and a network of independent authorized dealers to serve customers who purchased at a lower volume. A company may not be involved in the retail market but instead serve as an original equipment manufacturer (OEM), supplying materials to another manufacturer who, in turn, makes the product and sells it in a retail market. In part, the means of distribution are determined by the company's structure and the context in which the product competes. A company that already has a system of regional facilities is more likely to distribute a new product through company-owned regional warehouses than a company that would need to establish them.

The final element of a marketing plan is promotion, which includes sales and advertising. Again, the techniques employed vary with the nature of the product and market. Whether the users are reached directly or indirectly, the sales force in a large company is rarely under the direct supervision of the marketing director. Sales is an industrial activity that is treated separately in this guide.

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The marketing department assists sales through promotion, training, and technical support. It designs sales campaigns for a product in concert with sales management. It prepares literature both to instruct the sales force about the new product it will have to sell and to educate its customers. In high-technology industry it devises training programs so the sales force will have the necessary knowledge to sell its product lines. The department also helps design commission and incentive schedules to motivate the sales force.

Promotion can be indirect; aimed not at the ultimate consumer, but at intermediate marketers. Retailers are reached through such vehicles as trade shows, education, promotional materials, and sales contests. Consumers are reached through rebates, direct mailing, demonstrations, and advertising. Such consumer promotions even occur in cases where the company's product reaches the consumer only as incorporated in another company's product. Manufacturers of synthetic fibers do this often; Monsanto regularly promotes its Acrylan™ acrylic fibers to consumers. Part of Du Pont's marketing plan for neoprene was designed to convince consumers of rubber goods (such as automotive engineers) to demand that their suppliers supply them with neoprene parts.44

Advertising is a more prominent part of marketing plans for consumer goods than for other kinds of goods; all but one of the 125 largest U.S. advertisers in 1969 were selling goods or services directly to retail consumers.45 However, advertising is a part of the marketing plan for other types of goods and services as well. Advertising in the business and trade press can move information about a product to potential buyers more quickly and broadly than sales calls and can also serve to introduce or keep a product or a company name in the minds of the target audience. When Control Data began marketing the 1604 computer in 1959, it did not advertise. Its target market was narrow, technically sophisticated engineering and research facilities that needed raw computing power, and the company knew who its potential customers were. When Control Data decided to broaden its market in 1962 to include customers who might use a computer for both scientific and business work, it began to advertise the Control Data name in magazines such as Datamation.

Marketing usually continues for the life of the product. Periodically, the marketing department evaluates the successes and failures of its marketing plan for a given product or line. On the basis of that evaluation and additional marketing research, a new marketing plan may be devised. The scope, magnitude, and direction of the marketing plan for a product changes as the product matures and as the importance of the product in the overall company plan rises and falls. Marketing efforts frequently continue long after the product ceases to be of major current significance. As late as 1970, long after the Control Data 1604 computer

44 Forrestal, Faith, Hope, and $5,000, 131-134. Smith, "Ten-Year Invention," 49-51.

45 Derived from Marketing Strategies of America's 125 Largest Advertisers (Chicago: Crain Communications, 1970). The exception was Du Pont, which nonetheless spent heavily to advertise their synthetic fibers to consumers.
ceased to be actively produced, the company maintained a small marketing effort to place used 1604s acquired by the company in trade.

**Marketing: Documentation**

The central document in marketing is the marketing plan for a given product, line, or service. The size of a marketing plan may vary enormously, depending upon its scope, complexity, and importance to the company. In all cases, it describes what goals a company intends to achieve with its product, and how it expects to reach those goals.

While the marketing plan is the most prominent item in the process of marketing research, development, and planning, documentation is produced throughout the process. Market analysts write reports giving the conclusions of their work and making recommendations for action. To do this they conduct market surveys and collect background files of consultant reports, published materials, forecasts of future events, and other studies. Many of these other studies are more narrowly focused reports prepared by the market analysts on topics such as costs, sales, production capacity and efficiency, competitive activities, and alternative technologies. If the impetus for a new marketing effort comes from a new achievement in product development, this is documented in an interdepartmental memorandum or more formal proposal or report. Sometimes, information about other manufacturers' products are contained in reports from engineers or consultants.

Other individuals in the marketing department prepare drafts for parts of the plan, often on the basis of a brief sheet of marketing objectives prepared by marketing management. As the plan will call for efforts on the part of several distinct company departments, drafts will frequently be exchanged with these other departments. At a minimum, this leads to interdepartmental memoranda containing reactions to the proposed plans. Alternatively, it leads to the draft being passed through interdepartmental committees. Like all committees, these produce agendas, memoranda, and minutes. They may also produce revisions of the proposed marketing plans.

At the end of the time period of a given marketing plan, which typically is one year, the marketing department may prepare an evaluation of the plan, comparing the goals, objectives, and strategies set by marketing with the results actually achieved. This evaluation serves as a major basis for subsequent plans for the product. There may also be interim evaluations prepared during the year.

The degree to which the process of pricing is documented obviously depends on how pricing decisions are reached. Many corporations have a formal pricing committee that produces minutes and memoranda. Other pricing information may be incorporated in the marketing plan. All firms produce a price list for individual products and lines.
The most common documentation of advertising are the advertisements themselves. While many companies have advertising departments, few do all of their advertising work in-house, relying instead on independent advertising agencies, especially for print and broadcast media advertising. Thus, much of the documentation consists of correspondence, meeting minutes, and reports between the company and its agency. Internal advertising departments themselves are more likely to handle direct advertising such as company magazines, product literature, and promotional films. Internal advertising departments also may take the lead in company promotions, working with product line managers, for example, to design exhibits for trade shows. While the exhibits themselves rarely survive the shows for which they were designed, they can often be documented by exhibit plans or designs prepared beforehand, and photographs of the exhibit themselves. In addition, films, slide shows, or literature prepared for an exhibit may survive the exhibit itself.

Training materials for salespeople include sales manuals, instructional videotapes or films, sales conference literature, and other records associated with special training classes. Most of these records will be produced in concert with the sales department. Sometimes, marketing representatives will only play an advisory role in the production of these materials; they will want to ensure that instructions to sales people do not conflict with the message that marketing intended to convey to customers.

Marketing: Additional Observations

Marketing has a substantial impact on most other corporate activities, and marketing organizations do their work in conjunction with other corporate departments. Hence, it is common to find copies of marketing documentation among the records of various other groups -- research and development, production, senior management, sales -- as well as within the records of marketing departments proper. Marketing plans themselves are the records most likely to have received wide circulation.

Though marketing plans are highly proprietary when they are current, they seem to be distributed widely within a company; an effective marketing plan will involve a number of individuals from production, research, planning, and other areas. It is good for the archivist or historian that marketing plans receive such distribution because the plans are generally poor candidates for long-term preservation until the archivist intervenes. Marketing deals with the here and now and perhaps the near-term future. Short-term marketing plans are often seen as having little further relevance once they have supplanted by next year's plan. Information about market conditions is often seen as having a short, usable life and, as such, must be replaced often. RCA's research and recommendations on CBS's announced EVR video recording system became valueless once CBS abandoned its development efforts in 1972. All
of the marketing work done over the years on the video disc became irrelevant (or even worse, part of a discredited past to live down) when RCA abandoned the product in 1984.\textsuperscript{46}

Part of the reason that past marketing plans are perceived as having little value is that these plans deal in expectations and objectives, and not in actual events. Also, while it is part of the role of research and development and corporate planning to take a longer view, marketing's perspective is traditionally short-term. Sales records, production logs, and even marketing evaluations describe what happened, but even these quickly become old, unusable information for everyday business. The implications for archivists and historians are obvious.

There are numerous variations and twists on standard marketing practices that can be found within corporate annals. Large corporations, for example, engage in intracompany marketing; they may have such a diversity of activities that make it difficult for individuals in one unit to realize what other capabilities the company possesses. One division within such a company may have other divisions as a target market. Once General Electric began producing its own computers in the early 1960s, its computer department moved to replace IBM machines in use throughout the company. While it may be assumed that buying one's own products would be natural, this is not usually the case in some companies. Records relating to such practice can often provide interesting insights to the multi-divisional relations of a large company. GE's Computer Department engineers often complained that they were forced to purchase GE electrical components when other manufacturers' components were either cheaper or more reliable. In turn, the Computer Department resorted to "heavy-handed tactics" to displace IBM installations at GE.\textsuperscript{47}

Marketing research documents can provide valuable insights into the attributes of competitor's products. In high-technology industry, where a competitor's new product release can decimate sales of a product line, marketing is constantly looking for information about other manufacturers' products. The Computer Division of Philco saw the Control Data 3600 computer as a threat to the market for its 212, and this prompted discussion about Philco acquiring Control Data.\textsuperscript{48} Such a reaction would not be contained in Control Data's own records. Consultants are often hired to assess the competition within a particular market, and the result will be a special report to the company. These reports are treated confidentially.

\textsuperscript{46} Graham, \textit{RCA and the Video Disc}, 146, 213-219.

\textsuperscript{47} Thomas J. O'Rourke Oral History Interview, May 29, 1987, in Scottsdale, AZ. OH 133. Conducted by Bruce H. Bruemmer for the Charles Babbage Institute, University of Minnesota. From transcript, 19.

\textsuperscript{48} Herbert S. Bright Papers (unprocessed), CBI 42. From folder, "Acquisition of Control Data, 1962." Charles Babbage Institute, University of Minnesota.
until their proprietary value has diminished. Alternatively, a company may have its own in-
house experts assigned to track the competition.

Marketing research is an area that is particularly prone to automation. Advances in
technology have allowed analysts to use microcomputers where previously only mainframes
could be used. Microcomputer software, such as Lotus or SPSS, is used extensively by
analysts, even though the data may have originated from a mainframe. Because the
provenance of the data can be impossible to trace, it is difficult to assess the historical value
of such data (assuming the data values are documented enough to be intelligible in the first
place).
6. Sales

Sales activities are designed to convince customers to purchase the company's goods and services. Sales may be direct to the customer, through an authorized dealer (such as with Apple microcomputers), to another manufacturer, or a combination of these outlets. Though the terms "sales" and "marketing" are often used interchangeably, sales is largely governed by the strategy that marketing devises for a product. Unlike marketing, the sales effort focuses on the customer rather than the market. In the corporate hierarchy, sales is usually subsidiary to marketing, and the sales director reports to the marketing director. Alternatively, in a large multi-divisional company, marketing may be a corporate staff function while sales is handled within each division. In smaller companies, the two functions may be combined, or sales may be handled by manufacturer's representatives, who are independent salesmen representing the product lines of a number of firms.

The sales force for a large corporation can be substantial, easily numbering in the hundreds or even thousands of individuals. The force is organized in a hierarchical fashion. Typically,
only senior sales management is centrally located at corporate or divisional headquarters. The sales representatives themselves are based in one of a number of branch field offices spread around the country and run by branch managers. If the company has a large number of field offices, they are likely to be grouped into districts or regions, each run by a regional sales manager. Relative to corporate offices, field offices may be lightly used; they serve primarily as a base of operations and a location for support services for the sales force.

The essence of the sales representative's job is calling on customers in the field; time spent on paperwork or meetings in the office is time deflected from customers. IBM's long-time president, Thomas Watson, Sr., liked to pay occasional visits to branch offices. It was company lore that the branch manager was well advised to see that no sales representatives appeared in the office during Watson's visits; the president would take it as a sign that the representatives were not doing their jobs. The district sales office structure is standard in the corporate world because it promotes efficiency; a sales representative working out of a sales office in New York is in a better position to give rapid service, form a continuing relationship with, and keep track of New York customers than would a sales person working out of a central office in Minneapolis. Moreover, in the best of circumstances a large portion of a sales representative's time (with corresponding expense to the company) is spent in travel. Carefully located field offices help to minimize travel time and costs.

Most commonly, the field sales operation is organized geographically, though it may instead be organized along product lines or customer classification. These alternatives are most common where a specific expertise is believed necessary to stimulate sales. Selling to the federal government is one example of this. There are many specific techniques, such as learning one's way through the massive bureaucracy, qualifying as a supplier with various government agencies, getting on lists for requests for proposals, writing proposals in the appropriate style, and complying with federal regulations and paper work. Thus, the Control Data Corporation in its founding year of 1957 established only one out-of-town office, in Washington, to deal with the federal government as a customer.49

Large companies often use more than one sales approach. For example, IBM has long used both comprehensive branch offices in smaller markets and industry-specialized offices in large markets. One former IBM executive recalled that the branch offices he supervised in the 1950s in Grand Rapids and then Kansas City sold all of IBM's product lines to every IBM customer within the territory. But in a very large market, such as Chicago or New York, IBM opened offices to specialize in selling to particular industries, such as financial services, transportation, and manufacturing.50 This strategy is not without problems, especially if

49 Henry Forrest, Day Files, Control Data Corporation Records, Charles Babbage Institute, University of Minnesota.

product lines overlap. For a time, NCR had different sales forces for computers and accounting machines. The computer salesmen found that the accounting machine salesmen would try to convince customers not to buy a computer, thus undercutting computer sales from the same company.\(^{51}\)

Sales representatives do far more than fill orders. A major portion of their effort in their meetings with customers and potential customers is aimed at building relationships that will lead to orders. Often, this work consists of learning what a customer's problems are and devising solutions to those problems that utilize the company's products and services. Sales representatives also follow up on the orders they obtain; they act in a sense as the customer's advocate within the company, to see that the company delivers what the sales representative has promised. This activity is not based solely on fostering a long-term relationship for future sales; representatives often receive substantial commissions from the sale of support equipment, supplies, and add-ons. Sales representatives also spend a significant amount of time reporting to superiors in the corporation. They submit reports on each of their accounts on either a periodic or per visit basis. This does more than give sales management an opportunity to evaluate the representative's work. Collectively, these reports serve management in the company as a principal means of feedback from the field. Sales representatives, because they are the people in daily contact with customers, are in the best position to uncover areas of customer satisfaction and dissatisfaction, as well as areas of customer interest for additional products. The information flows back to marketing (for use in adjusting strategy) and production (for use in adjusting product flow).

The size and character of a sales force varies widely from company to company, and even from division to division within a company, depending on the nature of the products involved. The sale of an expensive, complex product, such as an airplane or mainframe computer, may require months or even years of sales effort, involving the production of technical publications, presentations, written quotations, draft contracts, and meetings with senior salespeople and corporate executives. But as the potential return is a multi-million dollar order, the investment is well worth the time. Such large-scale sales typically require substantial, continuing sales support afterwards; the initial order commonly leads to additional possibilities for products (such as peripherals and replacement parts), training, and service. If the product is not to be delivered until well after the sale (as is common with large computers and jet aircraft), the sales representative works closely with the customer during the interval to help plan the installation of the product, to see that the transition to the new machine will be as smooth as possible, to ensure that the customer's needs are being met, and to develop customer support.

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While sales of smaller ticket items benefit as well from the establishment of long-term sales representative-customer relations, it is financially impractical to make these extensive investments in time unless the product or service can be sold in large enough quantities to produce sufficient revenues. When the individual sale is sufficiently small, the company may not sell directly to users at all but through middlemen. Thus, the Cummins Engines Company has a small national accounts sales force that sells its diesel engines and components directly to the largest users of the products, but reaches most users through a network of independent distributors, who in turn employ their own sales forces.\textsuperscript{52}

The particular character of a given high-technology industry plays a large role in determining the size and character of its sales force. Pharmaceutical companies, for example, typically employ large sales forces to call on physicians. The CIBA-GEIGY Corporation estimates that its sales representatives call on 150,000 to 200,000 doctors per year. Yet, with few exceptions, the physicians buy and stock virtually no drugs themselves. However, as prescription writers, they determine what drugs will be sold by pharmacies and hospitals, and the markets the CIBA-GEIGY sales force needs to reach.\textsuperscript{53}

It is common for technologically innovative companies to hire sales representatives with technical backgrounds. Technological training enables sales personnel to better understand the products they sell and thus enables them to work with customers, who are often technologically sophisticated themselves, to demonstrate how the company's products can meet the customer's needs.\textsuperscript{54} This is the normal practice in the specialty chemicals industry. Rohm and Haas, for example, has long recruited bachelor's level chemists and chemical engineers for sales positions. One IBM executive noted as early as 1960 a trend away from recruiting salesmen with general backgrounds to those with technical expertise.\textsuperscript{55}

Technically trained sales forces are not universal, especially in areas where technically trained personnel are in short supply, e.g. in the computer industry in the 1950s and 1960s. When this happens, the company's chief alternative is to hire individuals already skilled in the art of selling and give them enough training to have a basic understanding of the technology, along with access to technically skilled individuals who can be called upon for assistance. This practice was followed by Control Data in its early years. One leading salesman of 1604


\textsuperscript{55} Simmons, \textit{Inside IBM}, 129.
computer systems came from a background selling heavy machinery and won his position by convincing company CEO William Norris that he could sell anything.\textsuperscript{56}

Each sales office is run by a branch manager who has a two-fold duty. The major part of the job is administrative: supervision, motivation, and training of the sales representatives in the branch. The branch manager assigns territories and sets individual sales quotas subject to guidelines from corporate sales management. He does so on the basis of corporate expectations, projected sales for the individual territory, and the ability of the representative. In many companies, the branch manager has the responsibility for recruiting new sales representatives within the district. A lesser part of the branch manager's time is spent selling, handling directly a few particularly difficult or important accounts, and assisting sales representatives with their customers as needed.

The duties of higher sales management at the corporate headquarters are more completely administrative and supervisory, although even at this level the manager may deal directly with a few customers. Sales directors bear overall responsibility for supervising the sales force and maintaining its productivity and thus for placing the products in the hands of the customers and bringing in revenue. Central sales management is responsible for training new recruits, a task that can be extensive. Many companies hold courses to teach sales recruits the "company way" as well as the product line. This training may give engineers the opportunity to move into sales. This was true of the General Electric Computer Department, where engineers could enroll in courses like "The Psychology of Selling."\textsuperscript{57} Sales directors also devise continuing training programs and sales conferences for veteran sales representatives, so that the company's men and women in the field will be well versed in the firm's new products and ideas.

Sales management is in some ways more difficult than other supervisory positions because sales representatives do much of their work alone on the road and therefore have far more independence of action than most other corporate employees. The sales director must find and choose the right outgoing, self-starting workers, train them, keep them motivated, make them feel part of a team whose other players they infrequently see, keep them up to date on company policy and products, and oversee their work. The sales director is responsible for devising and administering a compensation plan for the sales force that will provide the right incentives to meet the company's objectives. He or she also works with marketing to devise sales strategies and campaigns and serves as the conduit through which knowledge of market and competitive situations learned by the field representatives is transmitted to other corporate functions such as production and product enhancement.

\textsuperscript{56} Gayle Norberg, interview with the authors, January 25, 1988. The salesman was Harold Brooke. His name was mentioned by a number of sources.

\textsuperscript{57} George Jacobi Papers, CBI 41. Box 2, from folder "Sales Situation Management Program, n.d." Charles Babbage Institute, University of Minnesota.
Sales: Documentation

The sales representative, being out in the field, has little opportunity for the informal contacts of face-to-face meetings with other corporate employees. As a result, sales work traditionally has created a broad paper trail. The central document created in the sales process is the customer contact report, field representative report, or sales memorandum; the exact name may vary from one company to another. A sales representative typically files one of these reports on an official company form for each visit to each customer. Thus, a large volume of such reports are produced. The quantity plus the unaggregated nature of the reports makes it impractical for most companies to save more than a sample of these records. They rarely make it past the regional office, so they are less likely to have been routinely preserved. Some companies supplement or replace these customer contact reports with periodic reports, where a sale representative will write summaries of meetings with individual customers over the previous month or quarter. This latter form is particularly common where the number of customers per sales representative is small and the frequency of contact great. It has become increasingly common in recent years for these reports to be computerized. The sales representative writes his or her reports directly on a computer and transmits them electronically to a regional or central computer. Regional sales managers use the contact and periodic customer reports as the source material for regional sales reports that they send back to the home office, which, in turn, may issue sales notices or sales bulletins.

Sales representatives commonly supplement their visits with correspondence with their customers. These may serve formally to confirm a verbally-reached understanding, answer additional questions, or provide additional information. Sales representatives also regularly use and distribute a variety of product literature prepared by the marketing department.

There are several other types of sales documents commonly found, especially in government sales. The most important of these are requests for proposals, which describe work that the government wants done and invites bids from qualified applicants, proposals which respond to these, correspondence indicating acceptance or rejection of the proposal, the contract, and records relating to administrative matters.

A sale may result in a formal sales contract, depending on the size and complexity of the deal. If there is a contract, it may either follow a standard form prepared by sales management, or be a specially drafted document recording the results of specific negotiations. Government sales virtually always result in a formal contract. Government contracts follow government-specified rules and contain "boiler plate" materials designed more to ensure compliance with laws and regulations than to expedite the delivery of goods and services. A sale results in an invoice, or bill of sale. This typically will be issued by corporate accounting, and not sales, but the salesperson frequently receives a copy or at least a summary

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of the invoices for his or her accounts. A sale generates other intracompany documents because the order has to be prepared, processed, and shipped, but the character of such documents varies greatly from one company and product to another. These additional documents may include bills of lading (which list and acknowledge the receipt of goods), authorizations to ship, credit checks, change authorizations, and anticipatory sales manufacturing authorizations. The latter is used to inform production about likely orders before they are actually confirmed. This process is particularly important in the production of machines that normally would not be stocked in large quantities.

The central sales office uses several different means to communicate with and manage the sales force. It produces several types of internal sales literature, such as sales kits, offering guidelines on how to sell a particular good or service. It sends out price lists, schedules detailing such things as commission rates, quotas, and product availability, and product descriptions and brochures for sales use. It produces various documents to motivate the sales force to increased sales such as brochures outlining sales contests in which sales personnel can earn bonuses or prizes by surpassing sales targets or outselling other sales personnel. Large companies often produce special internal newsletters, bulletins, notices, or other periodicals specifically for sales personnel. The central office writes many types of memoranda, both general broadsides to groups of sales personnel and individual internal correspondence to particular salespersons covering specific situations. Also, the office will produce agendas, minutes, speeches, and other records from sales conferences.

These documents sent from the home office to the sales force are only part of the records produced in the process of sales management. Sales directors also serve as the conduit for the transfer of information between the field sales force and other corporate operations. Thus, sales managers produce regional and national summary sales reports for use by departments, including planning, production, shipping, marketing, and personnel information. They also produce sales forecasts, in which they predict near-term future sales. The district sales manager periodically produces written evaluations of the employees he or she supervises, as well as other personnel records. The manager is also responsible for keeping a ledger of each sales representative's commissions, when appropriate.

Sales: Additional Observations

In the course of their work, sales representatives produce large quantities of customer contact reports, but these reports are in several ways problematic for the historian and archivist. They tend to be highly focused on individual meetings, and represent intelligence that quickly becomes obsolete (in the corporate viewpoint), often as soon as the next report on the customer is filed. For this reason, sales reports are likely to be too sketchy or too limited in scope to have high historical value. On the other hand, detailed reports sometimes can be the best source for a frank appraisal of a firm's product line. The sales representatives write their reports in the field or the branch office. Typically, they keep one copy for their own files and
give one to their district manager. A few companies require that copies be sent to the
corporate sales office, but the volume of reports generally makes this impractical. District
managers use these reports in supervising their subordinates, and as the basis for the district
reports sent up the line. Thus, the individual contact reports are generally maintained in the
district offices.

At some point, a sales office might ship its old records back to headquarters, but more
commonly the records are maintained or discarded on the district level. As sales people tend
to have a short-term orientation in their work, they are not likely to see value in maintaining
these records for an extended period of time. Unless such files are centralized as a matter of
policy, individual customer reports are sent to corporate headquarters chiefly through special
circumstances or serendipity. Archivists may wish to retain samples of regional or district
records if it is not possible or worthwhile to retain a full set of such sales records.

The general scarcity of customer contact reports at a firm's headquarters was confirmed at
Control Data. Sales reports were there either because they were created and saved when the
company was small, or because there was another, overriding reason to keep them. There
was a single folder containing a set of a salesman's contact reports and associated records
such as an employment agreement; these had been filed after he was dismissed and disputed
the terms of his severance. (For an archivist, the preservation of this file of records would
raise issues about privacy rights.) There were a few customer contact reports in the files of
corporate managers where special circumstances led these higher officials to call on a
customer themselves. Bound sets of monthly customer status reports prepared for corporate
management existed for the first four years of the company's existence, but in 1962, these
were replaced by more conventional regional summary reports.

Documents created or sent to corporate offices are far more likely to reach corporate records
storage. Thus records of sales management are the most likely sales documents to be found.
These records set out the company's sales strategies and campaigns. This was the situation
at Remington Rand, where sales reports listing contracts and number of computers sold and
leased were retained by the heads of the computer division.

Because sales work is the one activity that directly involves customers, documentation of
sales may be possible through the records of the customers themselves. Customers are likely
to hold only certain types of records, such as sales literature, contracts, and perhaps their own
internal reports of vendor contacts. Only one signed contract for the sale of a 1604 computer
was found in Control Data's archives; it was for the machine Control Data sold to C-E-I-R
in 1962. The contract made it to Control Data's records warehouse only after C-E-I-R was
acquired by CDC. The records of academic computer centers, in particular, can be a good
source of sales information in the computer industry. The University of Minnesota computer
center purchased several computers from Control Data, and the negotiations with sales
representatives are reflected in the center's archives. The majority of these records deal with
questions internal to the university such as interdepartmental charges for use of various
machines, scheduling plant services work to construct a suitable space to house the computer, and the like. But some of the material is of more direct interest in documenting the company. There are over a dozen pieces of correspondence between Control Data and the University outlining the negotiations for terms and conditions for the 1604 the university ultimately purchased, as well as similar documents for other machines the university considered. No similar records were found in the Control Data files. The center's records also contain a series of documents describing the acceptance tests that representatives of both parties performed on the specific machine before the University accepted it. In many cases, the best source for documenting sales activity in the field may be records held by the customer.
7. Product Support and Enhancement

The technological complexity of high-technology products precludes their complete transfer from development to marketing after their introduction. For continued success, the product must be supported and often times improved; development does not stop when a product enters production. Responsibility for this type of activity falls between marketing and development. The decision to continue to support a product is often made within the marketing department; the department also receives input about enhancements through sales representatives and other field personnel. They best understand the shortcomings of a product from the perspective of the customer, and know what enhancements will best improve the product. Yet the actual support and enhancement is performed by engineers in a development laboratory or department. Organization of product support and enhancement can occur within existing departments, or be organized separately. Often the work is conducted by short-lived teams rather than formal organizations. Sometimes product enhancement laboratories are part of a company's research and development operations, although they are functionally distinct. Because support and enhancement is a hybrid business
function that is particularly prevalent in high-technology companies, it is discussed here separately.

Although product support can be as simple as making staff available to answer questions over the telephone, in the case of industrial durables it often requires the use of field engineers involved with products already held by the customer. Some technological products, such as computers and nuclear reactors, require large amounts of maintenance at a level of expertise that initially must be supplied by the manufacturer (or sometimes by specially trained third parties). Many problems in these complex machines are discovered in actual use, and correcting them is an integral part of customer support. The maintenance of large computers requires a full-time staff of engineers, and these may be supplied under contract by the manufacturer. Alternatively, either when the maintenance demands are routinized (such as aircraft maintenance) or the work being done is classified, maintenance is performed by the customer or a third party shop. Even then, the customer needs to be taught what maintenance is necessary and how to do it.

Employees of the customer must not only be taught how to maintain the product, they also need to know how to use it. The level of support will vary with both the complexity of the technology and the sophistication of the user. When Control Data initially marketed the 1604 to the most scientifically advanced users, they were able to do so with little training support. As they sought to expand the market for the machine, they discovered that the additional markets required more software and training to use the system.

High-technology companies in many industries establish applications departments, distinct from research and development laboratories, to support major product areas. Their purpose is to assist the customer in using the company's product and, in most cases, to encourage further sales. In the computer industry of the 1960s, these applications departments were particularly active in writing custom software to meet the needs of individual customers, although some laboratories wrote more general programs as well. Control Data established an applications department in 1960, whose initial assignment was to write special-purpose software for several 1604 computers as part of a contract from Lockheed Aerospace. Applications groups work not only to develop applications for the product line but also to instruct the customers in its use. They do this directly through contact with the customer and indirectly through the preparation of technical manuals.

Product enhancement is closely related to product support and involves improving the product either to prevent its obsolescence, to make it more competitive in the marketplace, or to change its characteristics to new standards of operation. After the Dolby B noise suppression system was developed for consumer audio products in the 1970s, manufacturers offered external units that could be attached to existing tape recorders and added internal Dolby electronics to their existing product line. Many tape recorder designs remained unaltered except for the addition of this one product enhancement. Problems with the model 1607 tape drives that Control Data built from third-party components and sold as part of
1604 systems threatened the success of the computer itself, leading to the in-house development and manufacture of tape transports and the introduction of the model 606 and model 604 tape drives. The improved characteristics of these drives in turn required modification of some of the circuits of the 1604 itself, yielding the 1604A and 1604B variants of the original machine. Enhancements can be made in the field to change the performance of a product to conform with government regulations, for example. Conversion kits are available in the aircraft industry to modify aircraft engines to meet lower noise requirements.

In large corporations, product enhancement may be part of each manufacturing division. Often, these groups are under the direction of more junior researchers than would be the case in a product development effort. The more senior or more highly placed researcher commonly moves on to another assignment when a product leaves development for production. This was the case with the 1604. In mid-1960, both designers, Seymour Cray and James Thornton, left the 1604 project for more advanced development work that eventually led to the 6600 computer. The company established at that time a "1604 Product Improvement" project within the Engineering and Product Development department under the direction of a project engineer who had been the engineer in charge of the assembly of 1604 serial number 1. Over the remaining four years of the 1604's life as an active product, the product improvement group included at least two other project engineers. It engaged in a broad range of activities, including the investigation of the use of improved components such as transistors, the introduction of major modifications (such as the higher-speed buffer capacity of the 1604A), and the revision of product manuals for both field engineering and customer use.

Some types of product support and enhancement are peculiar to a specific industry. The computer industry developed user groups, where users of a particular machine, such as the 1604, periodically gathered with company representatives to work on common problems and exchange ideas and applications. User groups are peculiar to the computer industry; they are significantly different from industry associations, which usually do not involve customers.

**Product Support and Enhancement: Documentation**

Several different activities are grouped together as product support and enhancement. They differ in documentation and so are best treated individually.

1. Field Engineering

The field engineer's basic guides are a set of **field manuals**, **technical manuals**, **parts books**, and **technical data handbooks** for the product. They are typically more detailed than ones produced for customer use. If the product is a machine, they cover in detail a machine's circuitry, design, and operation. They also contain directions for common repairs and standard maintenance and **diagnostics**, a set of procedures or tests that the engineer can run
to locate the source of a problem. Manuals and diagnostics are periodically revised to keep them up to date as more is learned about the product under conditions of use and as the product is modified.

Between revisions of a manual, the product support group at the development site keeps the field staff informed of new knowledge about the product through technical notes. Records that describe changes that the field engineers will need to make to their customers' machines are known as engineering change orders.

The field engineer typically keeps a record of the performance, maintenance, and repairs performed on the product in a maintenance log. One place where the information from maintenance logs is summarized is in periodic field engineering reports that the engineers use to report back to the company on the operation of each product. These reports are supplemented by memoranda or special reports to the company on particular problems.

2. Applications Department

The applications department is involved in a form of product development work, and its documentation is similar to that found in research and development. There will be lab notebooks, periodic reports, and perhaps a formal technical report for distribution when the project is finished. Where the documentation for an applications department differs from that of a development laboratory is in external communication. The applications laboratory will be in close touch both with the customers (is trying to help and with the field engineers and sales representatives who work directly with that customer. This will be documented by correspondence and perhaps memoranda or minutes of meetings, although some of the direct personal contact is not documented at all. Often the decision to pursue a particular area of application will be found in these last three forms.

3. Product Enhancement

Although functionally a distinct group, the product enhancement laboratory is structurally similar to the applications laboratory. It differs in its goal, which is to improve the product itself rather than increase its applications. However, the documentation created by the two is largely the same. One difference arises from the laboratory's responsibility for general changes in products (as opposed to custom changes). Hence, it will produce revised field manuals and user manuals, or technical notes and reports documenting the changes. User manuals differ from field manuals in the depth of technical information they contain. The former are not intended for use to repair or maintain a machine but simply to instruct how a machine or system is to be used. Other records include more wide-ranging documents such as correspondence, memoranda, and monthly reports.
4. Customer Training and Education

Companies often offer additional training beyond that given by field and applications engineers. Formal classes, when offered, will yield attendance rosters, course materials such as syllabi, handouts, and texts, and periodic reports from the instructor to his or her supervisor. Training centers or schools will have administrative records, student records, and material relating to the curricula. Training can be conducted through the use of audio/visual materials, such as videotapes, films, and even computer-based education programs. Customer groups, such as computer user groups, produce records common to other professional organizations, such as agendas before the meetings, proceedings afterwards, newsletters, membership lists, correspondence, and memos.

Product Support and Enhancement: Additional Observations

With the exception of the maintenance logs for individual products, and correspondence to or from the engineers at specific customer sites, field engineering records are produced in multiple copies. The documents are needed for easy reference by each customer engineer. There is therefore a set at each customer site that has a full-time customer field engineering staff, and sets may be found either in individual possession or at regional offices for each travelling field engineer. In addition, several sets may be kept at central company locations for use by other groups (such a product enhancement and production) working on the product, and a master set of at least the manuals is kept in a technical library. Note that each set of field engineering material may differ from each other, since the equipment of different customers may differ depending on the product involved.

At Control Data there were listings for hundreds of boxes of key lines (i.e. camera-ready masters) for manuals and other technical publications published over a twenty-year period. Fortunately, each of the thousands of documents had a unique publication number, so those pertaining to the 1604 and its peripherals could be located. Field engineering manuals are generally considered company confidential and therefore less prevalent than user manuals.

The quantity of company technical work at customer locations varies greatly, depending on the nature of the particular product, so the nature and volume of customer engineering records will vary as well. Until recently, large computer installations involved high-level field engineering; the complexity and idiosyncrasies of the machines required a full-time maintenance engineering staff, which was usually provided by the manufacturer under a maintenance contract. In most high-technology industries, a manufacturer maintains regional staffs of customer engineers, who respond to requests for service and make periodic visits.

Technical manuals (both field and user manuals) are often the most detailed single source of technical information about a finished product. Yet, technical manuals in aggregate are voluminous, repetitious in content, and may be too detailed to justify their preservation.
Since many high-technology companies are likely to produce vast numbers of product manuals per year, appraising their historical value may present a dilemma. Depending on the scope of a company's product line, preserving each manual might be difficult to justify for even a company archives. The archives at United Technologies does preserve all technical manuals of its aircraft engines, elevators, and other products, because the manuals are valuable enough and the task of preserving them is manageable.\textsuperscript{59} However, IBM and many other computer companies do not preserve all of their manuals, possibly because the job is too overwhelming.

In cases where it is impractical to save all technical manuals, it may be possible to weed certain records pertaining to insignificant products. The criteria used to define the scope of a collection of manuals must be developed carefully with an understanding of the needs of different users. A machine may be a company's most popular product but not technologically innovative (like the IBM Personal Computer). Therefore, a historian of technology might be less interested in its product manual. In some cases only portions of a machine system may be historically significant. Yet if only parts of a system are documented, important information about the system may be lost. Other users, such as patent attorneys, are likely to look to manuals as evidence of the state of the art for the technology or as a specific evidence for a company's claim to certain technology.

Manuals go through a series of revisions as a product is modified and improved over its life cycle. Sometimes the revisions of manuals will be clearly indicated, as in the case of manuals for the Control Data 1604 and its associated peripherals. Each successive revision of CDC's manuals is alphabetized, and the inside front cover of each manual lists the date of issue for each revision and the pages changed in that version. It may be important to preserve different versions of a manual in order to document improvements in a product. Here, again, this may prove impractical. Furthermore, it is likely that no information will be obtained by comparing different versions of a manual unless other documentation is available. One engineer who was involved in the development of the Bendix G-15 computer commented that it would be impossible to understand from the manuals alone why certain changes were made to the G-15.\textsuperscript{60} In some cases it may be useful to preserve the original manual and its last revision. Here, guidance from individuals who were involved in a machine's development or use can be most helpful.

The geographic location of the group responsible for applications work varies from company to company. It may be attached administratively to marketing, production, or even a research department; it may even be largely autonomous. Its operational home will have a significant

\textsuperscript{59} Discussion with Anne Millbrooke, Archivist, United Technologies, December 5, 1988.

\textsuperscript{60} Statement by Harry Huskey at the Historical Treatment of Technical Documents conference held in Minneapolis, Minnesota on November 29 and 30, 1985, sponsored by the National Endowment for the Humanities.
effect on the location of its records. The main applications group for the Control Data 1604 was an independent division, known first as the Applications Analysts Organization and later as the Computer Application Division. Despite the impression that might be given by its broader title, it was devoted exclusively to the development of custom and standard software for the 1604 and other Control Data computers. This is typical in the computer industry because it is chiefly by software that the capabilities of computer hardware is harnessed to customer needs. The Applications Analyst organization was established in Palo Alto, California, far from Control Data's headquarters, because its initial assignment was to write a custom software package for California-based Lockheed Industries. Afterwards, the group remained together, taking on additional assignments for custom software for 1604 users, and for standard programs, especially operating languages. Most of the records were destroyed at that remote location, and few records from the applications organization were found at Control Data headquarters. Those that were discovered included the software reference manuals.

Training manuals and course materials can be a valuable guide to the level of information needed to correctly use the product. As they are written for someone who is not yet familiar with the product, they tend to be more accessible than other guides, although they may still presuppose a certain amount of general technical knowledge. Of course, some of the best sources for understanding the use of products are not produced by the manufacturer. The U.S. military often develops its own use manuals for sophisticated electronic devices.
8. Financial Services

Although nearly every large company has a financial department whose head reports directly to the CEO, financial services are not organized under a single unit within a large business. There are several departments which cover aspects of financial services. The accounting department probably represents the largest organizational unit devoted to financial controls, and it formally reports to a controller (or comptroller). Other departments include internal auditing, tax (which also usually reports to the controller), and the treasurer's office. But regardless of formal reporting relationship, financial services are a part of virtually every business function and every department. It is difficult to imagine a single corporate activity that is without financial ramifications, if only in expenditures for personnel and supplies. Thus, accountants, bookkeepers, and payroll clerks work in every part of a corporation. More often than not they report functionally to the controller, rather than to the managers whose accounts they are keeping. Dual reporting relationships are common as well. The work of accountants and bookkeepers may be less visible, and their contributions to corporate success less obvious than that of others, but it is no less important. The ultimate goal of a
business is to make a profit, a feat that is difficult to accomplish without keeping close track of expenditures, income, cash flows, and other financial data.

The financial control process begins with very detailed record-keeping far down the corporate hierarchy. Records are routinely produced for every transaction, both internal and external. For example, a detailed payroll file is kept for each employee. The most obvious function here is issuing a correct check to each employee each payday. This activity requires maintaining a record of the correct pay rate, the correct deductions, and the hours and days worked. But that is only the beginning. Money paid out to employees is charged to the corporate unit in which the employee works. Deductions are correlated and sent on, with copies of the appropriate form, to the correct agency (e.g. state and federal internal revenue departments, insurance companies, company savings plans). Aggregate payroll data are accumulated in several ways to answer a variety of questions from corporate and government officials. A similarly complex, multi-level process occurs for other sets of financial transactions. Production costs are calculated, capital goods are depreciated, bills are paid, bills are collected. Some of the data created are used largely for internal tracking at the level produced, but other financial information, particularly aggregated reports, forms an important part of the input used by managers and executives throughout the company in their decision-making.

In addition to the routine accounting done in the normal course of business, large companies typically have a separate internal audit department whose purpose is to periodically verify the accounting records, ascertain that the records are properly kept, meet proper professional standards, and serve corporate purposes. The function of internal auditors is to see that corporate financial resources are properly spent in every part of the company. Internal auditing directly serves top corporate management, rather than the individual departments and units. For publicly held corporations, many of the internal auditing functions are mandated by laws such as the Foreign Corrupt Practices Act or by regulations issued by agencies such as the Securities and Exchange Commission.

Internal auditing should not be confused with external auditing, a legally mandated requirement that publicly traded companies regularly bring in independent certified public accountants to audit their financial records and certify that they are correct and in accordance with accepted accounting practice. The results of external audits are only one of several types of financial information that a publicly held company is legally required to report to government agencies, such as the Securities and Exchange Commission (SEC). Large quantities of additional aggregate data must be prepared and distributed in conjunction with activities such as stock, bond, or debenture issuance, acquisitions, and divestitures.

Much of this information comes not from the controller's organization but from that of the corporate treasurer, who is the official in charge of the external aspects of corporate finances. He or she supervises those activities classified as "money management" (such as investments), maintains a market for the company's securities and stock, and interacts with banks and other
financial institutions. Thus, the treasurer's activities are less likely than the controller's to relate to a particular industrial process but instead to corporate activities in a broad sense.

One further class of financial controls is tax records. Paying a wide variety of taxes is a necessary part of doing business. Not only do tax records have to be kept to meet legal requirements, tax information is important to corporate decision making as well. Almost any activity that a company contemplates is liable to have tax consequences. Hence, companies have teams of people whose responsibilities are to gather data needed for tax purposes, calculate tax liabilities, prepare tax forms, and propose measures to manage future tax liabilities. This can be a very complex activity for a company operating on a national or international scope. A flaw in this process can leave the company with massive excess tax liability. Moreover, supporting financial documents, going well beyond those created in tax calculation itself, must be saved for an extended period of years, a period that varies with different sections of the tax code. A company must maintain enough evidence to defend its actions if audited. The audit process for a large business is complex, and it may last over many years.

Financial Services: Documentation

Most companies have a financial handbook or manual that lists financial activities and documents used within the company. If available, these should be used to determine the types of financial documents used by a company.

The central documents in the accounting process are known as ledgers. A company typically keeps a separate ledger or set of ledgers for each type of activity that is tracked: accounts receivable, accounts payable, payroll, depreciation, and so on. Every transaction of the appropriate kind is recorded in the correct ledger. Thus, ledgers present a very detailed, but raw and unanalyzed, picture of a company's financial activities. Through the middle part of the twentieth century, ledgers were kept in loose leaf books. It is possible that one may find individual ledger sheets rather than complete volumes in a records search. Increasingly from the 1960s, ledgers have been automated, computer-processed, and kept in machine-readable form. Where this is the case, print-outs of ledgers are typically produced every month. Many ledgers, especially computerized ones, use numerical codes instead of names for items such as customers or account types, and thus they may be impossible to decipher unless one has access to an account listing.

Ledgers, however, are not the most detailed level of accounting records. Ledgers are assembled from individual documents like customer invoices, vouchers, bills received by the corporation, cancelled checks, and payroll stubs. These documents may be found in a simple numerical order or in files, such as customer accounting files, where they are collated by account.
Ledgers record financial events that have already occurred. Allocations of financial resources for future corporate expenditures are documented in budgets. These budgets serve as guidelines for how much money a corporate unit has to spend in a given time period and how it is to be divided among unit activities. Departments submit periodic budget reviews explaining how they have actually spent the budgeted funds and where they stand with respect to their budget.

Financial statements are another major class of accounting records. Typically, they are produced by internal auditors. They vary greatly in both comprehensiveness and level. One can find detailed financial statements listing every transaction for a single company unit in a given month. One can also find annual corporate financial statements, such as statements of operations. One special type of financial statement summarizes a company's profits and losses, and assets and liabilities, over a given period. This is known as a balance sheet.

Most financial statements are prepared only for internal corporate use and are considered confidential documents. However, certain financial statements are published and a matter of public record for publicly held companies. The Securities and Exchange Commission requires that each publicly held company annually submit an externally audited financial statement as Securities and Exchange Commission form 10-K, and that the annual submission be supplemented by quarterly forms 10-Q, and also by monthly forms 8-K when there are extraordinary item charges and credits that regulations require to be reported. A brief but still significant summary financial report appears in a company's annual report. Additional financial documents, known as registration statements, are submitted to the SEC when a company issues new stock, bonds, or other securities. State regulatory commissions may require other documents in addition to those mandated by the federal government.

While tax returns, like securities registrations and reports, are documents prepared for submission to the government, they are considered confidential, and not part of the public record. Hence, copies are unlikely to be available outside of the company. A large company files many, often complex returns covering a wide variety of taxes paid to a wide range of jurisdictions. In order to prepare these, tax accountants prepare tax worksheets and trial returns. Returns are subject to audit by the taxing authority and these audits leave large paper trails of correspondence, tax audit work papers, memoranda of negotiations, and settlements.
Financial Services: Additional Observations

The most common problem facing a person who is sifting through a collection of financial documents with the intention of selecting those records with archival value is the large volume of records produced in the first place. A financial handbook, if available, is an invaluable aid in identifying the function and variety of records. Where records management policies have not been effective, there often seems to be little logic to the types of financial records that are retained. Records with no obvious long-term, financial value often predominate, including even duplicate payroll stubs and monthly print-outs of computerized ledgers. At Control Data, many examples of these records had been saved in large quantity. It may well have been that these records were initially intended to be retained for only a short period of time and were merely forgotten once they had been sent to records storage.

Unaggregated and unanalyzed records such as those described above are likely to be of limited archival value. Financial documents of enduring value result from data consolidation, summary, and analysis. However, a corporation typically generates a multi-leveled hierarchy of increasingly summarized and analyzed financial data. It is not always clear from the title of a financial document where it stands in this hierarchy of summation, nor is the title always a satisfactory indication of the character of the information it contains. C-E-I-R, a computer service bureau acquired by Control Data, produced a series of monthly, thick computer print-outs labeled "consolidated source ledgers." These proved to be a comprehensive list of transactions for the month, some in amounts under one dollar, listed by division, department, and account number. The consolidation consisted of having all the entries in a single machine-readable file. C-E-I-R also produced monthly computer print-outs of the "physical assets inventory." These proved to be monthly lists of every capital item the company owned at any location, down to the level of clocks and office waste baskets, with original cost, depreciation schedule, and monthly depreciation for each item. The historical value of documents such as these C-E-I-R ledgers is negligible. Yet, the project files of financial data may be valuable to the history of a project and often are found with the project files rather than in the financial department.

While most users of financial data would prefer to have this information in a summarized form, it is difficult to define at what level the data are sufficiently aggregated, especially when an archives serves different types of users. A historian of science and technology, or even a historian of business, is unlikely to want much more than highly summarized annual compilations, such as balance sheets, statements of operations, and department budgets. An economic historian may desire considerably more detail as may a tax auditor or a lawyer.

One potential use of financial records is the tracking of financial developments over time. Financial summaries on the divisional level can be highly valuable to historians. The historical value of any financial data is likely to be enhanced if they can support comparisons over a period of years. Such data will help document a company's trends of growth, decline, profitability, and changing emphasis. Companies themselves use a variety of sophisticated
financial tools beyond simple statements of profit and loss to measure these patterns. These measures include return on investment, return on equity, return on net assets, research (or other expenditures) as a percentage of sales, and sales per employee. Corporate management itself produces documents tracing these measures over a period of years for contemporary corporate use. While these can be important documents, their historical use is problematic, as reporting categories change over time, so that it is very difficult to make meaningful comparisons. A company that has reorganized its operations typically produces documents that restate its past operations (three to five years) in ways that permit the tracing of the performance of product groups that did not exist as such in previous years. A company may similarly restate its results to allow for acquisitions or divestiture, hoping thereby to separate the performance of continuing operations from others.

There may be considerable value in going through some types of accounting files, even if they are of doubtful archival value. A major portion of the C-E-I-R records stored at Control Data were "customer accounting files," arranged by account type, then alphabetically by customer. A list of folder titles might have considerable value in lieu of a list of C-E-I-R's customer base, but the primary contents of these folders, duplicate invoices and monthly statements of account, are of limited archival value. However, some files contained significant documents. In a number of cases where an account was in dispute, perhaps because a customer alleged poor performance on the part of C-E-I-R, the customer folder contained a collection of correspondence and memoranda discussing the dispute. This correspondence documents not only the dispute itself but some of the range of C-E-I-R's activities and the way in which it handled customer relations.

Many regulatory documents required by state and federal agencies are produced and maintained by departments with responsibility for financial services. It is not possible to generalize about the historical value of all such records. Even though some records, like form 10-K mentioned above, are available through the government, it may be desirable to retain them for the sake of convenience because they have obvious historical value. Other public records, like state financial documents, may have less inherent value but are more difficult to obtain and thus should be considered for preservation.
9. Legal Support

Like financial controls, legal support includes a variety of individual functions that serve to support the entire company. Most corporate activity has legal ramifications, so corporations usually have legal staffs to handle some or most of such matters. Among the areas undertaken by legal departments are contracts, counsel, regulatory affairs, and litigation. Patenting, which sometimes includes related trademark and copyright work, is another important legal activity, but it is such a specialized area that it is usually handled by an entirely separate unit within the legal department. The amount and range of legal activity handled in-house varies widely, both from industry to industry and from company to company. Most corporations retain outside legal counsel to supplement the in-house work and provide more specialized expertise.

The most pervasive legal activity is the drafting of enforceable contracts. The agreements reached between parties in the course of business need to be translated into a written form that meets the requirements of the law and are therefore enforceable in court should there be
a dispute about the terms of the agreement. The drafting of contracts can be simple and straightforward or enormously complex. In one extreme, company attorneys draft standard contract forms to be used in cases where similar transactions will be carried out many times. They are used in situations such as employment contracts and the sale or lease of standard products.

In unusual circumstances, or when the monetary value of the transaction is very high, a contract or a series of contracts specific to the transaction is drafted. This may be a very complex process, involving numerous drafts and lengthy negotiations between attorneys and principals representing all parties. In the case of Control Data's decision to develop the University of Illinois PLATO system as a commercial product, it took two and one-half years of negotiations and many draft contracts to reach a set of seven contracts acceptable to both the company and the university. Though the length of this process cannot be attributed only to legal issues, considerable effort was devoted by attorneys on each side to seeing that their client's interests were protected.

Agreements reached in principle between two parties may collapse if the attorneys are unable to reduce the agreement to mutually acceptable language. To try to prevent such a collapse, attorneys are often part of negotiating teams from the beginning of the process, rather than being brought in at a later stage.

The chief legal officer of a corporation is known as the general counsel. The general counsel is high in the corporate hierarchy and typically reports directly to the chief executive officer. The name "general counsel" is more than just titular; it describes the major part of the responsibility of the individual and department. The consideration of legal factors is necessary in all aspects of corporate decision-making and execution. For example, the management of IBM, a company that dominates portions of the computer industry, must carefully consider whether any of its strategic plans might have antitrust implications. In 1956 IBM signed a consent decree to settle an antitrust suit that the government had brought four years earlier. Assuring compliance with the provisions of a consent decree and other legal agreements directed toward future company efforts is part of the legal department's responsibility. A general counsel does advise the rest of top management on strictly legal issues such as how to respond appropriately to a lawsuit, but that is only one small part of his or her task.

One area where legal counsel has become increasingly important in recent years is regulatory affairs. Since World War II, there has been a steady proliferation of federal and state agencies issuing regulations governing corporate activity. The degree of regulatory control varies greatly from industry to industry. The computer industry is less heavily regulated than chemical or broadcasting industries, for example. Still, all firms must comply with the regulations of, for example, the Occupational Safety and Health Administration. OSHA regulations may have major consequences for the design and operation of manufacturing facilities. One area where many high-technology industries are particularly sensitive to government regulations is in foreign operations and exports. Radar, computers, and other
military electronic devices are advanced technologies with national security implications. They are therefore subject to Department of Commerce export controls, and government licenses are required before much of this technology can be shipped to another country.

Contrary to popular impression, litigation is a small part of the overall work of business attorneys. In general, litigation is not even part of the normal corporate legal routine. It requires both special skills and particular knowledge of the venue where the case may be tried. Thus corporations usually refer litigation work to their outside counsel rather than perform it in-house. The in-house legal staff works with the outside counsel in a supportive role.

Litigation can be a long and complicated process. Control Data sued IBM in 1968, alleging that IBM had damaged Control Data's business by engaging in anticompetitive practices. The case was settled out of court five years later. During the interim, Control Data's attorneys examined (through a legal process known as discovery) over one million pages of IBM internal documents, posed and answered long series of written queries known as interrogatories, took depositions from numerous IBM employees, and toward the end drafted a complex legal agreement. IBM's counsel undertook corresponding work. All this effort was devoted to the prosecution and settlement of a legal dispute that never went to trial, but then, out-of-court settlements are the norm for civil suits.

While a company's chief patent attorney often reports to the general counsel, the patent department's activities are largely autonomous. A patent is a legal document awarded by the government to an inventor in recognition of an advance in the state of the art. Products, processes, and compositions of matter are all eligible for patents. A patent entitles the inventor exclusive control over his invention for a specified number of years, currently seventeen in the United States. In return the inventor, as part of his application for a patent, discloses the details of his invention into the public domain, so that it may be used freely once the statutory period expires. Although the government issues patents only to individual inventors, corporations generally require employees to assign their patent to the company as a condition of employment.

The chief duty of the patent department (sometimes named the "corporate intellectual property department") is to work with the research and development group to identify company research and development efforts that have produced patentable advances, and then work with the inventor/employee to draft, file, and prosecute patent applications. Since patents are generally valid only for the country of issue, additional applications may be filed with the patent offices of other countries. The patent department also keeps track of all of a company's patents and their uses, and it searches for instances where others may be infringing on a company's patents. Such infringements may lead to lawsuits or other legal action.
The defense of patents is somewhat problematic in high-technology industries. It typically takes three or more years to prosecute and receive a patent, by which time the invention may have become obsolete. Twenty-six years had passed before a suit over a patent involving the invention of the electronic digital computer was resolved. This does not mean that patents are without value for high-technology firms. Honeywell believed that the ramifications of paying for licensing fees on Sperry Rand's computer patents was sufficient to justify the expense of contesting the patents in court. Many high-technology industries simply perceive patenting as a mild defensive strategy. Some technological processes, such as the production of the integrated circuit, are so complex and require so many patented technologies that infringements would be difficult to pursue. Instead, companies are apt to seek cross-licenses in order to maintain their position and avoid litigation.

Sometimes patents are not filed in order to prevent a competitor from duplicating an innovation. Legal remedies to protect inventions do exist down the road, assuming a patent is granted, but the damage to a company in the meantime may be severe. Companies may instead decide to maintain the invention as a trade secret.

While patents cover inventions, copyright and trademarks provide a somewhat analogous protection for other intellectual property. Copyright protects particular means of expression but not the underlying ideas themselves. Books, plays, musical compositions, and the like are eligible for copyright protection. Thus, a computer company can copyright the manuals or other documentation it produces for its products. A patent offers more secure protection, but a copyright is valid for a much longer period, the author's lifetime plus fifty years under current U.S. law. Software falls into the grey area between the two legal domains. It may be patentable if it is part of a "new, useful, and unobvious process" that deals with something outside of the computer itself, such as automated production. Otherwise, it can only be copyrighted. Trademarks are "words and other symbols used to identify a particular company's goods and to distinguish them from the goods of others." They are used primarily as a marketing tool to protect the product names, slogans, and designs that have become part of the identity of a product. Unlike patents and copyright, trademarks can be renewed indefinitely, if protected. Conflicts between trademarks can be settled in court, and companies must be vigilant in protecting trademarks. They can forfeit their exclusive use of a trademark if it is subject to continued misuse or falls into common use, like the term "aspirin."

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61 Brock, The U.S. Computer Industry, 64.


63 Heyel, Encyclopedia of Management, 1230.
Legal Support: Documentation

The central documents in contract law are the contracts themselves. A complex contract will typically go through several drafts. Commonly, copies of each draft are circulated to interested parties on both sides of the negotiation, and each individual writes marginal comments and suggested changes on his or her copy of the draft. In addition to the drafts, there is typically extensive correspondence between representatives of the two sides, internal memoranda among members of each side, and sometimes minutes of meetings held in the process of negotiations.

Legal counsel and advice is an informal process, and much of it takes place in meetings between the attorneys and their internal corporate clients. Sometimes these meetings are undocumented, but other times they lead to minutes if the gathering was large or summarizing memoranda if the gathering was small. If a legal question requires substantial research before it can be answered, that research is reported in the form of a legal brief. Most material will be gathered in a legal case file.

Much of the regulatory work within the company consists of documenting that the firm is in compliance with relevant regulations. This requires the preparation and submission of appropriate forms and notices to the regulatory agency. The exact terms of compliance are often subject to negotiations between the company and the regulators. These will produce correspondence, memoranda, and minutes of meetings.

The documentation of litigation can be voluminous and can vary with its nature. Civil suits begin with a complaint, filed with the court and served by the plaintiff (the party initiating the suit) on the defendant. A pre-trial brief supporting the complaint must be filed by the plaintiff and may be filed by the defendant. There are series of motions filed with the court, which lead to judicial orders from the court, compelling each party to respond and cooperate in specified ways. Each side may issues sets of interrogatories, to which the other side must respond. This is followed by a process known as discovery, where the court requires each side to produce specified groups of internal documents for the other's use in proving its case. Supplementing this, lawyers from each side will take oral statements as transcribed depositions from witnesses for the other side. Most commonly, all of this will lead either to a legally binding agreement between the two sides to settle the dispute, or else to the granting of a motion by the court that the suit be dismissed. If one party to a civil suit is the government, the agreement will take the form of a consent decree, worked out by the two sides but subject to the approval of the court. Once accepted, such a consent decree has the force of law.

Only occasionally does a suit actually proceed to a trial. In these cases, there may be issue briefs filed by both sides, as well as exhibits presented by each side in the process of demonstrating its case. These exhibits are more likely to be documents than artifacts. The record of the trial itself is the transcript, which is produced by the court reporter. After the
trial, post-trial briefs may be issued by either side. At the conclusion of the trial, the court issues a judgement, or finding of law, which gives the court's decision and the measures to be taken by one or both parties to comply with the court's finding.

The central document in patent work is the patent itself, but this is the culmination of the process. The process of deciding whether a patent should be sought produces internal memoranda among the patent department, the researcher, and research and development administration. Some companies have more formal procedures, where special internal disclosure forms are used instead of memoranda. Once the decision is made to proceed to a patent, the attorney submits a patent application to the U.S. Patent and Trademark Office. This may be strictly textual, or it may contain supporting drawings and blueprints. Exchanges of correspondence between the patent office and the patent attorney occur in the process of patent prosecution. When conflicting applications are submitted, the patent office issues interferences. Obviously not all patent applications are granted; those not awarded are referred to as "abandoned." Most patent departments maintain patent files that are organized by patents not pursued, abandoned patents, successful patents, and interferences. These files will contain considerably more information than is sent to the Patent Office, including memos, correspondence, and other supporting documents. Related to patents are licenses covering the use of other's patents and cross-licensing agreements relating to the sharing of patents between two owners.

Copyright and trademarks are more straightforward, usually consisting of government forms used to register the intellectual property.

Legal Support: Additional Observations

Legal staffs tend to create large quantities of records, at least in part because the production of documents such as contracts, briefs, and patents are a major part of their work. Their other major activity, counsel, often leaves a significant documentary trail. In addition, lawyers as a group tend to be more concerned with record keeping than other personnel. Documents form much of the raw material with which they perform their craft, so they tend to be sensitive to the advantages of well-organized files. Though files concerning the relationship between Control Data and the University of Illinois were held by a number of individuals and offices at both institutions, the most coherent and complete set was kept by the Control Data attorney leading the negotiations. The documents stored in these files went far beyond legal drafts and briefs to many that substantially documented the PLATO system and Control Data management's plans for PLATO development. The original context of such documents is usually lost when they are added to a legal department file; the documents have been collected and rearranged in an order suitable to the attorney's needs.

The largest collections are produced in the process of preparing for major litigation; legal staff involved in litigation typically collect, read, analyze, and file enormous quantities of material.
Some of this material will originate in the company, some will be obtained from the other side through the discovery process, and some will be obtained from third parties. A computer print-out shelf list for Control Data's stored records identified hundreds of boxes as containing legal files from a major Control Data lawsuit. For a large case, one or more clerks or paralegal assistants may devote their full energies to keeping track of documents. The legal staff may also develop case-specific filing systems or indexes to make these documents accessible. Control Data developed a particularly powerful computerized indexing system and database for use in the IBM lawsuit. IBM was sufficiently concerned about the existence of the database (and its availability to the Justice Department for use in a government antitrust suit) that it insisted on the database's destruction as one of the terms of the out-of-court settlement.

Without such an indexing system, locating a particular document may be close to impossible. Fortunately, many large lawsuits since the 1960s have made use of the computer in generating and tracking exhibits and other legal documents. One collection at the Charles Babbage Institute relating to the Honeywell vs. Sperry Rand patent trial contains a detailed keyword-in-context index of the trial exhibits and testimony. The existence of such indices can significantly enhance the value and usefulness of a legal collection, archivists should make every effort to locate and preserve them. Another collection at CBI relating to the U.S. vs. IBM antitrust trial has an incomplete and unusable index to trial exhibits and depositions. While the exhibits themselves constitute an important resource on the computer industry, the collection is virtually unusable without the compilation of an index. While the use of the computer lessens the expense of producing finding aids, there is no question that it is an expensive undertaking for a repository.

Archivists and historians must bear in mind that indexes produced by lawyers are intended to be used by lawyers during a court case. Few, if any, indexes will use a controlled vocabulary, thus forcing researchers to be creative in searching for terms. Also, a lawyer's intent in indexing a document is often related to supporting legal, not historical, issues; a legal index will reflect this bias. Finally, nowhere is there a better example of the importance of provenance to the interpretation of information. Where a researcher might be able to infer information from the location of a letter in a file, there is no such luxury when a letter is examined as an exhibit out of its natural context. In this regard, a collection of exhibits is a poor substitute for corporate records in their original state.

Lawyers use the mass of documents collected in litigation to reconstruct past events in order to demonstrate the argument being constructed. Such analytical documents may become exhibits themselves. They are a valuable source of information, although one should use them with a realization of the purpose for which they were created. For example, in the process of collecting information for use in Control Data vs. IBM, the Control Data attorneys put together several reference volumes. One of these is a list of every Control Data computer produced through 1970, together with information on shipping, acceptance, and (where
applicable) return dates; project number; and the names of all customers who successively owned or leased the unit.

The depositions of witnesses can provide first-hand narratives similar to oral histories, although they must be used with even greater caution than oral histories as the witnesses will likely have been coached beforehand by their attorneys. The deposition given by Seymour Cray in 1960 as part of Sperry Rand vs. Control Data contains much detail and insight into Cray's work patterns and habits while developing the 1604 computer that is otherwise unavailable to researchers. On the other hand, depositions of individuals taken by their legal adversaries may not yield any information. A Control Data lawyer once deposed an IBM employee who would not admit knowing his name or age because, since he was a baby at the time, he was too young to remember such facts.

If a case goes to trial, some of the documents collected and depositions taken are likely to be entered as evidence in court. While this is typically a much smaller quantity of records than that collected by the attorneys, these records may become part of the permanent court record, along with the transcript of the case and the decision. However, the collection generated by the company may be more comprehensive than what is stored in state and federal records centers.

Litigation may lead to significant documentary by-products. One of the standard histories of the American computer industry, Franklin Fisher, James McKie, and Richard Mancke, IBM and the U.S. Data Processing Industry: An Economic History (New York: Praeger, 1983), originated from their participation as consultants for IBM in the U.S. vs. IBM lawsuit, and is largely based on the "historical narrative" they wrote in their consulting roles.

The documents that lawyers produce for all of their work (and not just litigation) commonly exist in multiple copies in different locations. This is a consequence of the nature of the work, which has them working for clients, even if internal, and with attorneys for the other side and their clients. All four of these parties are likely to have received copies of the documents. Thus, several copies of the various Control Data/University of Illinois agreements existed in the files of the Control Data attorney, individuals in relevant Control Data business groups, the laboratory at the University that had developed PLATO, and administrators at the University. When a company works with outside counsel, copies of documents typically exist with both the company and outside counsel. However, law firms generally consider such files as their client's property and are unlikely to make them available to third parties without express consent from the client.

Files pertaining to patents are likely to remain under the jurisdiction of the patent department for a long period of time. They contain much more information than the formal patent application that the government receives. The completeness of the files bears directly on their historical value, and this in turn depends on how patents are administered within a company. Small and moderate-sized companies are apt to use an outside patent firm to process their
applications. While in this case the company will maintain a patent file, much of the important legal discussion will be contained in the outside firm's records. Generally there is little question that files of approved patents have long-term value to historical researchers. However, files of rejected or abandoned patents are more difficult to assess. In one sense they are of little importance because they were not approved and had no further effect on the company's affairs. Taken from another perspective, they may contain useful discussion about the reasons for abandoning or not pursuing a patent. A company may decline to pursue a patent for strategic reasons, even if it believes it would be approved. Any correspondence in the file, as well as the technical information itself, is likely to be of value. For this reason, patents files should be appraised file-by-file. The files may be so disjointed that they defy interpretation by all except the most expert researchers. Foreign patent filings are likely to duplicate the technical information in the domestic application. If summary information is available about foreign patent applications, then the historical value of the individual foreign patent files is diminished.

Other intellectual property areas (copyright and trademark) present fewer problems in terms of preserving documents. Once copyright registrations have expired, there are few historical reasons to save them. An exception might be the case of computer software. The trademark registration forms are likely to be retained by the legal department in perpetuity. If they do become available, they are worth preserving, if only for their artifactual value.

Lawyers typically participate in a broad spectrum of corporate activities, often as members of committees. An attorney was one of the members of the committee sent to Washington to make a detailed study of C-E-I-R's operations prior to the consummation of its acquisition by Control Data. His assignment was to look for possible legal exposures that Control Data might inherit as part of C-E-I-R's business. The section of the committee report he wrote outlined several such areas. Also, a Control Data staff attorney served as one of six members of an "education services and products pricing committee." If the original records of such committees can not be found, the participation of the legal staff can serve to document the committee work.

Another important legal function is the defense of a business from legal entanglements through preventative measures. This role bears directly on the preservation of records, since lawyers often are involved in setting records retention policies for companies with records management systems. Too often the goal of a corporate legal department is to destroy records before they become "smoking guns," that is, records that can be used against the company in court. Many corporate records management systems were established in order to carry out this objective, because in court it is important to demonstrate that records are destroyed on a certain schedule according to company policy. A company might be held responsible for intentionally destroying evidence if it cannot demonstrate that orderly destruction of records was a matter of policy, not a response to potential litigation. Not all business lawyers agree with this policy. First, the act of destroying records can be a two-edged sword. While it may remove evidence that might be used against the company, it may
also destroy evidence that might defend a company's actions or rights. Second, it is nearly impossible to destroy all copies of a document in a large corporation. The ease with which copies of documents are produced make it difficult for even the most aggressive records management program to control the existence of certain records. Finally, some lawyers believe that education is a more effective defense than records destruction. John Sciamanda, a Control Data legal executive, felt that executives and support personnel could be educated to avoid creating documents that would later be used against the company.
10. Other Support Functions

Financial and legal services are only two of many support areas in a modern business, but they are the two with the greatest impact on the practice and documentation of high-technology industrial activity. This section describes other support functions that are commonly found in modern business. These functions are given shorter treatment because they are likely to be less significant for understanding and documenting high-technology activity, or because they are common to all business. This does not mean that they are insignificant from a historical perspective; they may create records that are important to certain areas of research. A labor historian, for example, might be interested in personnel and labor relations and make substantial use of the records created by those functions.

A. Facilities

The corporate facilities function can be divided into two classes of activities. The first is real estate, which includes the selection and acquisition (through purchase or lease) of new sites and the construction of new facilities. The second is facilities management, which includes the supervision and maintenance of existing facilities, the allocation of space within these facilities to various corporate departments and units, the equipment of these spaces to meet their intended uses, and provision of utilities and janitorial services.

Site selection is often particularly important for successful high-technology research and development operations. Many corporations have found that facilities with certain characteristics are desirable for recruitment and retention of superior research and development talent. While some corporate headquarters may be in large financial centers like Manhattan, other corporations may establish campus-settings of low buildings spread among spacious lawns, often in communities with good access to major research universities. The RCA Corporation (until its 1985 takeover by General Electric) had its headquarters in New York City, but its research division was fifty miles away in a semi-rural campus just outside Princeton, New Jersey. AT&T's Bell Labs also joined this trend towards research campuses in the 1940s when it moved from lower Manhattan to suburban Murray Hill, New Jersey. Entrepreneurs seeking to start high-technology businesses often seek out locations near major universities because they believe that this will enable them to draw upon the expertise at the university, recruit its graduates, and interact with related companies that have located there for similar reasons. This is one reason that major concentrations of electronics and semiconductor firms exist, for example, near Stanford University in California and MIT in Massachusetts.
Facilities managers have the responsibility for reallocating rooms and buildings as corporate units change in size. This frequently requires far more than moving furniture and re-routing telephones. High-technology operations often require special equipment, environments, and security. Until recently, mainframe computers required massive power supplies, re-enforced floors, special utility spaces, custom air conditioning, and separate fire safety features. Several high-technology research and production processes, such as the manufacture of integrated circuits, require dust and particulate-free "clean rooms." Chemical research laboratories need fume hoods, heavy ventilation, and provisions for lines to carry various gases to laboratory benches throughout the building.

Perhaps the most significant facility records for historical use are those that document buildings and their function. Detailed floor plans are usually kept by the department in charge of facilities until a building is no longer used by the company. At that point important evidence of the facility may be lost, although many of the detailed plans will probably pass to a new owner if the building is sold. Documenting the function of facilities is more difficult; some records will be saved by the units occupying the building. Lacking those, interior and exterior visual records, maps, and correspondence are probably the best alternative.

B. Libraries

Like records management, the business library is important primarily because of its effect on records of interest to archivists and historians. Most business library collections contain more than outside publications; they may include full sets of annual reports, company newsletters, newspaper clippings about the company, organization charts, form 10-K reports, and other material printed by or about the company. Libraries in high-technology companies may be specifically dedicated to maintaining valuable technical reports, product specifications, and product manuals. The sole purpose of one library at the Sperry Corporation was to collect, preserve, and microfilm technical reports, including reports produced for government classified projects. It is not uncommon for a large business to have a number of libraries with different collecting focuses. Any one of them may maintain historically valuable records or publications.

Some libraries serve the function of a company archives, especially when no other program exists to preserve records. Many business libraries are called upon to save the records of a retiring employee or advertising memorabilia surrounding a special project. In the 1970s the Kraft Corporate Library had a special room to house historical materials relating to its products and some of the early television shows sponsored by Kraft. Later, the company decided to establish an independent archival program that was in a better position to preserve the historical records. Some historical collections maintained by libraries remain under the library's jurisdiction, though their use and maintenance is rarely a high priority for a business library.
C. Personnel

The personnel function encompasses the recruitment, use, development, and compensation of a company's employees. Typically, these activities are organized in a personnel department. In recent years, personnel departments have given way to "human resource" departments, which may reflect a more expansive role than personnel departments have traditionally pursued in past years. As a support service, personnel works with and for other corporate departments. For example, when a production unit is establishing a new production line, it typically needs new workers. The personnel department will then work with production to identify the manpower needs (in both number and skills), recruit appropriate personnel either by hiring new employees or transferring current company personnel, devise and administer an appropriate wage and benefit package, and develop and sometimes offer appropriate training programs.

Another major personnel department activity is seeing that a company's personnel policies are consistent with appropriate government laws and regulations. These include the anti-discrimination, equal opportunity, and affirmative action regulations that have become a standard part of personnel activity for companies receiving government contracts and companies subject to state and federal regulation. There are other long-standing federal and state labor statutes, such as workmen's compensation laws, occupational safety, and the National Labor Relations act, that a company must follow and document.

The scope of the personnel department varies from company to company, especially with respect to professional and managerial employees. In some companies, personnel departments take only an advisory role with regard to recruitment and advancement of professionals, in others they take the leading role. In any case, the techniques of professional and managerial recruitment differ markedly from those of lesser positions. Professional recruitment, including that of scientists and engineers, is national in scope rather than local. It requires advertisements in national media, such as professional journals, recruiting trips to appropriate university campuses for entry-level employees, and elaborate interviewing. Often, senior level recruitment is done through outside consultants ("head hunters") who search out qualified candidates from national pools of appropriately skilled personnel who may not even be looking for new positions.

In addition to recruiting, personnel departments manage the company's existing work force. Personnel departments typically keep a long-term file for each employee. The material contained in these files may be minimal, consisting of little more than the sequence of positions the employee held, with relevant dates. Nonetheless, because these records deal with individuals they are considered highly confidential. Personnel departments are also responsible for administering the company's fringe benefits package, which includes such items as health and life insurance, company savings and profit-sharing plans, educational assistance, and pensions. Pension offices often are the best source for locating retirees, since
it is the responsibility of the office to know where to mail pension checks. However, such information is rarely made available to non-company personnel.

Most large companies offer internal training programs to their employees through a personnel department. These programs have several goals. Some help employees maintain and polish their technical, managerial, or interpersonal skills, others assist employees to cope with changes in the work place, and still others equip employees with new skills needed to advance in the corporate ranks. In addition to work-related training, many personnel departments offer programs designed to enhance general employee well-being, with the assumption that it is in the best interest of the company to have a healthy, happy employee force.

Many companies, especially those with large unionized work forces, have one or more specialists in labor relations. The main responsibilities of such labor relations specialists are to be a liaison with union officials and negotiate contracts to cover unionized employees. Such contracts are often complex; they not only specify wage rates and fringe benefits but many working-condition issues as well. While this may seem to be an area well within the run of personnel department functions, labor relations officers are sometimes found elsewhere in the corporate hierarchy. Since their work requires the application of labor law and involves contract negotiation and writing, some labor relations offices are found in the legal department.

Individual personnel files can be a valuable source of historical information about a number of different issues. Older business collections containing personnel records have been used to locate genealogical data, as well as to study labor patterns and practices. There are at least two reasons why personnel records in a modern corporation may be difficult to preserve. First, most businesses are motivated to safeguard the privacy of their employees and probably would not allow general access to personnel files. Second, the bulk of the records and their closed nature make them a low priority for most corporate archives.

While individual files may be impossible to save, there are other records within the department that help to document personnel activities. These include union contracts, training materials, general recruitment information, general correspondence files, and statistical and other summary reports on employees.
D. Public Relations

Public relations is intended to assist the company in communicating with the general public. This may involve fostering a better public image, conducting goodwill programs aimed at the local community, interacting with state and federal legislators on issues of concern to the company, or developing and distributing press releases of public announcements. Public relations, also known as "corporate communications," was not a common, distinct activity for many businesses until after World War II, though now it is rare to find a large business without some program.

The scope of public relations activities varies greatly from company to company. Sometimes, companies that produce no consumer goods or services, including many high-technology firms, give little thought to public relations. They operate under an assumption that the best public profile is one as low as possible, or that such relations can be effectively managed by other departments. But the activities of high-technology businesses, in particular, are entwined with a number of contemporary public issues such as hiring practices, the environment, exposure of the public and employees to hazardous conditions, the role of U.S. business in foreign countries, and production of military products. Businesses operating in this climate often need professional assistance to respond properly to the public's concerns.

Public relations activities may be defensive in nature and shaped to respond to incidents in such a way as to minimize the damage to the corporation. The department may help senior corporate officials formulate an appropriate strategy and response or have a department official present the response when formulated. The "company spokesperson" quoted in the media is generally a public relations official. When the issue is critical enough (such as the release of lethal gases at the Union Carbide facility in Bhopal, India), direct response by a representative of senior management, after consultation with the public relations director, is common.

However, most public relations work consists of planned, non-crisis oriented programs designed to foster public awareness of a corporation and its goals. Public relations officials respond to or route general correspondence written to the company, prepare press releases, handle consumer complaints if appropriate, and work with marketing representatives to announce product developments. Many "good will" activities are coordinated by the public relations department. They include allowing community groups to use company facilities, sponsoring or underwriting public activities in the community, lending corporate officials to charitable or public programs, and a wide range of other philanthropic efforts.

Public relations departments also engage in internally directed efforts. It is difficult for companies with thousands of employees and scattered facilities to maintain a sense of community and corporate pride, yet a company where such beliefs are widely shared will often accrue tangible and intangible benefits. Activities in this area range from company
newspapers to special campaigns aimed at particular groups of employees. The departments are often responsible for promoting various health programs that recently have been popular in major U.S. companies. They may attempt to communicate the history of the firm by sponsoring historical writing and establishing archives.

Public relations also may encompass shareholder relations, although in some companies this activity is found under the jurisdiction of the corporate secretary. Preparation and publication of the company's annual report is usually organized by the public relations department. It also orchestrates, under the CEO's guidance, the company's annual stockholders' meeting.

Public relations departments produce large quantities of records. In addition to annual reports and internal newspapers, they issue large quantities of press releases covering a wide range of topics. They may also maintain biographical files and photographs and may produce films, brochures, or other visual materials. Thus public relations departments are one of three likely sources (the others being advertising and photographic laboratories) for visual records of company activities. Most of these records have obvious historical value, and it is not surprising to find public relations departments holding corporate historical collections. Indeed, many corporate archives report to the director of public relations.

E. Purchasing

Purchasing is the function whereby the corporation obtains needed materials, supplies, and services from outside suppliers. Like traffic, it may be handled as a by-product of other corporate functions in firms of moderate size but through an autonomous department in larger firms. Large firms purchase large quantities of supplies, both for production and for office use, from thousands of suppliers. Coordination of such purchases allows for tremendous leverage with suppliers as well as economies of scale and can lead to lower costs, improved supplier service, and lower corporate inventories. The degree to which the purchasing function is centralized depends on several other factors. Relatively undifferentiated or routine items, like stationery, fuel, and standard laboratory supplies, are much more likely to be handled completely within the purchasing department than are unusual items or highly advanced technology. In the latter case, the purchasing agents generally work with representatives from the appropriate technical units to ensure that the suppliers are capable of supplying goods meeting specifications.
F. Records Management

Records management is typically a minor corporate function, but because its mandate is the management and storage of the company's written records, it is a function of high importance to the archivist or historical researcher. The records manager is responsible for developing and enforcing corporate or divisional guidelines for record retention and destruction. Developing such guidelines is a balancing act. It involves determining how long different classes of records will have business uses, calculating the substantial costs of record storage, and weighing the possible legal costs of retaining records that might be used against the company in future legal action. Usually, a general records schedule is developed in concert with legal, financial, and administrative personnel. It lists broad categories of records and recommends the period for which the records will be saved. For example, annual inventories of office equipment might be scheduled for destruction after two years. The guidelines may be codified in a records management handbook distributed for use by all corporate units. (A discussion of records retention periods appears in the section on legal support.)

Once guidelines are in place, the records manager is charged with storing, locating, and retrieving records no longer actively needed on-site by corporate units. Often, it is the responsibility of the unit storing the records to specify how long records are to be stored, when they should be destroyed, and how they are identified. Few record management operations append information as they receive records from units. Thus, if records are poorly described when they are sent to records storage, they are likely to remain that way. This practice has implications for archivists and historians, who are more interested in retrieving records by subject or topical keyword than by department. At Control Data, the content descriptions of records in storage rarely exceeded 40 characters per box. Since each unit assigned its own description to the material in storage, there was no consistency to the choice of terms. Thus records relating to PLATO might not even use the term "PLATO" at all. This not necessarily a sign of a poor records management system, because the object of the system is to retrieve box numbers, not subject terms. It does mean that the usefulness of many records management systems for identifying historical records may be limited.

Special consideration is given to the storage of records relating to government classified projects. Storage of such records is governed by federal regulations, and the records are typically kept apart from the general run of corporate records. Access to them requires both appropriate security clearance and the "need to know." Often, the management of government classified records is administratively handled by security personnel, separately from the records management department, unless the bulk of a corporation's work involves classified work.
G. Traffic

Traffic is the corporate function responsible for arranging all of a company's freight transportation, both intracompany and to customers. In a small firm this function may be handled somewhat informally as a byproduct of functions like production and sales. Large companies more commonly have traffic departments, which manage freight using both company-owned and outside carriers. Companies with multiple locations typically have a large volume of internal freight. Components produced at one plant may be needed for assembly of products at another. Finished products may need to be moved to a warehouse for storage until sold. Internal mail routing among locations can be substantial. Some companies operate their own internal truck fleets, sometimes supplemented by owned or leased rail cars, to handle the bulk of these shipments through their traffic departments. Sometimes, owned vehicles may be used for shipments to customers, but these are more commonly handled by common carriers. Here, the traffic department is responsible for making the necessary arrangements, which typically include selecting preferred transportation modes and carriers for various routes, negotiating rates and conditions, and coordinating shipping schedules with those of production and sales. Traffic departments commonly prepare formal guidebooks to their companies' transportation policies. These documents are known as transportation manuals and are distributed to internal clients. Most substantive historical records relating to traffic will be found in marketing or in a department responsible for distribution planning.
DOCUMENTARY PROBES

[Diagram of a tree structure with multiple levels and nodes]
By the time most high-technology firms consider their history, the volume of their non-current records usually has grown to a point where it is not easy to identify those records with historical significance. A documentary probe offers a pragmatic way to ascertain the scope of a company's documentation by extrapolating information from research on inactive, representative products. Unlike a traditional records survey, a probe can provide a shortcut to obtain well-rounded information about a company and can help to uncover enough history prior to a records survey to improve vastly the appraisal of a firm's historically valuable records.

A documentary probe is a study of a product which generates diverse historical, organizational, and documentary information from all facets of a company in order to aid in the identification of historically valuable records. It goes far beyond a "product package," a term used in business to note the development of descriptive and market information about an on-going product. Instead, a documentary probe uses research, interviews, records surveying, and the description of industrial activity to identify historical issues and activities that should be documented, ascertain how well those issues and activities are represented by extant documentation, and identify other areas needing to be documented. A probe is an iterative technique, building and refining in scope as more knowledge is obtained.

Probes are particularly effective for high-technology companies involved in the manufacture of goods with brief product life-cycles, such as computers, integrated circuits, communications equipment, genetic engineering products, medical diagnostic equipment, and semiconductors. These products tend to be subject to most of the functions of a business (R&D, production, marketing, etc.) within a relative short time span, about two to five years. A study of products with short life cycles affords a good representation of an entire business within the period that the products were developed and released. This assumes that the company has an integrated product line. If a company is highly diversified and has distinct divisions, the probe may yield information on only one division. A company like ITT, with many independent and diverse subsidiaries, would require at least as many probes as subsidiaries to adequately represent the company.

Products with long life cycles can also serve as subjects of probes as long as the study concentrates on their initial development and sales. The chief criteria for a product is that the period in which the product began development be within the past thirty-five years, because much of the research for a documentary probe is based on interviews of personnel associated with the product. Beyond that time, there are too few people to interview to develop meaningful information. As long as the entire history of a product falls within that time
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<th>STAGE</th>
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<tr>
<td>1</td>
<td>Develop general historical information</td>
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<td>2</td>
<td>Identify products for the probe</td>
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<tr>
<td>3</td>
<td>Develop information about the product, historical issues, and records using interviews and other sources</td>
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<tr>
<td>4</td>
<td>Identify and select records</td>
</tr>
<tr>
<td>5</td>
<td>Identify gaps in knowledge about products and other historical issues relating to the company</td>
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Table 1. The stages of a documentary probe

period, it may be used as a probe. However, if the goal of a probe is to determine changes in the organization of the company, then a product with a shorter life would provide a better picture of the whole organization at one point in its history.

A documentary probe employs a mix of traditional historical and archival techniques in five stages. First, general historical information about the company is developed. Second, a product or products are identified to serve as subjects of the probe. Third, information about each of the products is developed, important historical issues are identified, and records storage areas are located. Fourth, historically valuable records are identified and selected. Fifth, methods to develop information for undocument areas are considered, as are other probes, if necessary. While there may be considerable overlap between stages, it is important to the success of the probe to conduct it in this sequence because the results of each stage are used in each successive stage.

The first stage is research on the general history of the company. The goal of this research is to learn as much as possible about the firm in a short period of time and to acquire information about past products in order to be able to choose a representative product or products that will become the subject of the probe. The research will need to determine the objectives of the company, its strengths, weaknesses, its product offerings, its successes and failures, data about its prominent personnel, and how the company was perceived by it competitors. The research should be conducted using readily obtainable sources (as described below) common to any initial historical investigation. It would be unproductive in this stage to spend a great amount of time locating sources that document only a very narrow aspect of the firm.

Obviously, any histories written about the company should be consulted, although most high-technology firms will not have existed long enough to have been the subject of a formal
history or have produced their own. Sometimes employees are engaged in writing a history or reminiscence, or a company may have sponsored a short history for publicity purposes. Although these works may be historically amateurish or incomplete, they can prove to be a valuable starting place, as well as a source of names, dates, and other data.

Even if general historical works are available, other sources will need to be consulted. Most company libraries maintain sets of annual reports, which will provide financial data, names of officers, information about products and other essential information. If the company has issued publicly traded securities, much of this same information can be found in forms 10-K, which must be filed with the Securities and Exchange Commission. Even if companies do not have an archives, many maintain a "historical collection." Such collections may be formally managed by a company library or informally undertaken by an interested employee. They often contain organizational charts, important documents relating to the establishment of the company, and evidence of particularly successful products.

Other sources within a company will be useful if they can be easily located and constitute a comprehensive set of records over a period of time. Past strategic plans can provide detailed information about a company's expectations for new and old products, and they may reveal major organizational maneuvers designed to improve the performance of the company. Much of the same information can be gleaned from internal market reports and plans, and even from a full run of press releases.

Information available outside of the company should not be ignored. One of the most productive sources of general historical information about a firm is the press. Most newspapers report on the health of companies when quarterly and annual reports are released. In-depth features of even small companies are usually produced by local newspapers if a company plant or headquarters is in the locality. If the firm is large or its management newsworthy, national papers such as the New York Times and the Wall Street Journal may carry stories about the company. Since both of these national newspapers are indexed, it is easy to check for relevant information. Trade periodicals are also a valuable source, and the major publications are usually indexed (although rarely prior to 1975, owing to the relatively recent rise of computerized indices). They are written for a particular industry and include features on companies, management, announcements and analyses of products, and the position of firms within the industry. Examples of such literature are Aviation Week and Space Technology, Chemical Week, Communications News, Datamation (computers), Electrical World (utilities), and Modern Plastics. Technical journals and periodicals devoted to business functions (Corporation Training, Personnel) are not likely to be useful because they give little overall information about companies or product lines.

Other sources that normally would be too detailed for a general historical overview may be useful if information is particularly difficult to obtain. The company may have been the subject of study by state or federal agencies, and information might be found in government documents. High-technology firms, in particular, are popular subjects of state, regional, and
local development agencies. If the firm has been involved in litigation, even as a third party, trial exhibits and transcripts may contain valuable information. State archives or manuscript repositories should not be overlooked. Oral histories may have been produced by local historians, professional societies, or subject-related historical organizations.

For many historians and archivists, it will be tempting to continue this research beyond what is necessary to conduct the probe. Certainly, a point will be reached when the marginal benefit of further research will begin to diminish. It is difficult to gauge precisely the amount of time the first stage should require; the period that one may wish to devote to this stage may be considerably longer for a historian than an archivist. In some cases the research may take as little as a week. Since the immediate objective of the research is to choose the subject or subjects of the probe, the next stage should begin when a few products become obvious candidates for further study.

In the second stage, a product or series of products are chosen for further study. They must meet certain criteria if the documentary probe is to develop general information about the history of the firm and its documentation. First, the product should pervade the activities and strategy of the company. For example, a product that moved quickly through all of the functions of a business will yield more general information than a product that was simply remarketed. Similarly, a product that was a linchpin to the strategic plans of a firm is more likely to be the focus of activity than a product that was marginal to the plans. Second, the product should have had a significant effect on the company. The study of a significant success or failure is likely to reveal dramatic changes in a company’s organization and management and possibly in the documentation it produced. Third, the product should, if possible, document the interaction of the company with important groups outside of the company. This includes products that may have been developed jointly with other corporations, academia, or government. These joint efforts are widespread in high-technology, and they greatly effect the type of documentation that is produced. Since the study of such efforts is likely to provide some interesting exceptions to the standard state of documentation, the choice of products should be guided primarily by the first two criteria.

A documentary probe may be based on the analysis of one product, although a series of product studies will give better results. The most limiting factor in a single product probe is that it can only generate information on one period of time in the history of the company. This cannot be corrected by choosing a product with a long life, because the product will not uniformly engage all of the company’s business functions during its lifetime. For example, once aircraft are initially sold, certain business functions like production and marketing would no longer be involved with the overall product. There might be enhancements that would flow through all of the functions, but they would not be representative of an aircraft company’s main business: the development and production of aircraft. A probe based on one type of aircraft would only capture information about production during one point in time, although it would develop information about product support groups over a period of twenty years.
A probe that includes multiple product studies will capture general information beyond the time period of one product, and will often yield historical and documentary information more generally applicable to the entire company throughout its history. Ideally, the multiple-product probe uses three or four products that are strategically chosen to reflect important periods in the history of the company, such as its start-up, growth, and maturity. Not only will the organization of the firm be different during these periods, but the documentation for each function will vary considerably. Another useful approach is to choose different products to reflect interactions with different customers or in the case of joint research, different developers. In this case the probe might study a product developed under government contract, another developed in concert with a research consortium, and still another developed solely by the company without outside involvement. Yet another method of choosing products is to sample different product lines over time. The activities and documentation represented by most business functions will differ depending on the complexity of the product. For example, a company that produces both large, expensive products and small products in large quantities may use completely different production techniques for each type of product. Following both types of products would ensure that production was more adequately investigated.

Information from the general research in stage one may not offer a clear choice of products for the probe. This may be especially true of newer high-technology companies because information about their history is often more difficult to obtain than about established firms. In such cases an educated guess must suffice. A probe can be based on almost any product with some results; a multi-product probe stands an even greater chance of reflecting the activities and documentation of the company. At worst, the product study can be abandoned and a new product or series of products can be selected for the probe. Usually the choice of an uncharacteristic product will become apparent at the beginning of the third stage, when the direction of the probe still may be altered without investing too much additional effort.

In the third stage, information about each of the products is developed, important historical issues are identified, and records storage areas are located. The goal of the research is not to know absolutely everything about the history of the products but to know enough to be able to understand significant issues relating to them. Such issues include "turning points" in the development or sales of a product, decisions that had major strategic consequences for the company, and actions that led to improvements or failures for other products. At the same time, the probe will seek to determine the types of records that will document those issues and determine the physical location of the records.

Information for this stage is developed primarily by means of interviews of personnel who are knowledgeable about the role of the products in each of the business functions. Individuals that might be able to provide information were probably identified during the first stage of the probe. This list may be expanded by consulting organizational charts and project personnel lists, or more effectively by asking individuals known to have worked on the products. As in a "documentation strategy," the greater the involvement of experts on specific business
functions (i.e., company personnel) and the documentation (records managers, corporate librarians, and other archivists), the more effective the probe will be. For many of the functions, people from different levels should be consulted, as should individuals who have left the company. Interview subjects need not be top level executives, and in many cases they should not be. A middle manager for the production of a project may have a better idea about day-to-day transactional records than a person high in the hierarchy. The interviews do not need to be formal or recorded (although they may be a good opportunity for oral history). Because individuals may no longer live in the vicinity of the company, some interviews may need to be conducted by telephone.

The "description of industrial activity" in this guide has a central role in determining the nature of the interviews. Since it describes activities and documents that commonly occur with each function, it is used to outline topics that need to be covered in the interview. For example, the description depicts the process of pricing as an element of marketing and lists documents that often include pricing information. An interview of someone knowledgeable about marketing a certain product should include questions about pricing, and also about the records that would be generated from pricing activity. If there was some controversy about pricing, the interviewee should be asked if any records would document the problem. If an individual can not remember the types of documents involved, it is useful to ask for a description of current practice. Then you may ask the interview subject to compare present practice with that of the past. The interview should also include questions about the storage of records, or if they do not know, names of people who might.

As more interviews are conducted, critical issues about each product will appear. Was there any debate about how the product was marketed? Were there problems in the production? How were they resolved? Were there competing efforts in research or in development? How was the product's life extended? What was the nature of subsequent modifications? Did any patents come out of the product's development? Was the product involved in litigation? Who were its customers? How was the product sold? What was the competition like? As these issues are being uncovered, the interviews should document the nature of activities for each business function, using the description of industrial activity as a model.

The process of conducting the interviews is iterative, i.e. information gathered from the interviews points the way to other interviews and better information. This process spills over into the fourth stage: the survey of records. As interviews are conducted and information about sources of records is uncovered, the survey of records may commence. It would be possible to complete all of the interviews before examining the records, but this strategy would ignore a good source of information. The point of the probe is not to delay inspecting records until the very last stage, but to equip the archivist or historian with better historical

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information than could be obtained by looking solely at records. Certainly by this point, that goal will have been reached.

Records surveying involves briefly inspecting records to ascertain their content, dates, relevance to the products under study, their office of origin (provenance), and location (for future reference). The rate of this process must be swift, especially if the records are voluminous. With paper records, one may only need to scan folder labels to understand their content. Other records, such as machine-readable data files, will require a different method of surveying and may need to involve experts, such as computer systems personnel. A survey of complex records may need to be delayed until the expertise or resources are available to handle them. Further information about survey techniques may be found in the archival literature.  

The task of locating existing records may be the most problematic aspect of a documentary probe. It is simply not possible to characterize the records-keeping practices of all businesses. Some companies have instituted comprehensive records management programs that can account for every box of records. Others have no program and simply leave each office to determine records policy and storage. Records relating to the probe may be in records warehouses, in office files, in closets, in employees' basements, or in garbage landfills. Records managers and librarians should be consulted early in the probe; they will be able to furnish information about the existence and location of any formal storage areas. Interviews provide an excellent opportunity to learn about informal record storage areas if the interviewer is persistent in inquiring about records.

If possible, it is best to make decisions about the historical value of the records while conducting a records survey. If research for each of the products has been adequate, then the records surveyor can focus on locating specific records or records that document particular issues. There will be times when more information is required to make a decision. For example, a probe might reveal that special automated production techniques were used in the manufacture of one of the products. An interview of a production engineer may have also revealed that this process was described in a summary report. If a survey of records fails to uncover this document, other records might be able to provide some of the same information. The surveyor could consult the description of industrial activity for a description of other records that might document the activity, and he or she could confer with the same production engineer. The records survey itself might reveal other records that could be used.

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Detailed records about the interviews, records, and appraisal decisions should be maintained throughout this process for future reference.

In some cases, it may be impossible to document certain activities or issues. Records may have been destroyed or lost, information in existing records may be too sparse, or the company may not want to grant access to certain materials (particularly if they contain classified or highly proprietary documents). Increasingly, businesses are relying on communication technology such as electronic mail, which creates an ephemeral record, or the telephone, which leaves no record. There are situations when no records are created. When problems were encountered with the Titan rocket at United Technologies, a response task force was created to make recommendations. After its work was completed, the task force disbanded without leaving any documentation within the company.66

It is in the fifth stage that consideration is given to undocumented issues and activities associated with the products. Situations as described in the above paragraph may be documented through extraordinary means, such as through a comprehensive oral history project. It is at this point that oral history proves its greatest value; if enough knowledgeable individuals are available, a series of interviews on a particular issue can create an invaluable record for future research. Other types of documentation requiring special attention include artifacts and machine-readable records. A probe may reveal that the best documentation of a production technique is through the preservation of an artifact (such as an assembly robot), or a computer program. Both of these records would require significant effort to preserve, and the archivist or historian would need to justify the expense. However, information developed during the probe should be adequate to make such a decision. These special efforts need not be implemented, but they should be considered for future action.

If a probe is successful, it will develop information about the overall history of the company and its documentation, as well as other important issues and activities. The probe will help to identify other issues critical to the success or failure of the company, even though those issues may not have been directly relevant to the probe. For example, a probe based on a mainframe computer might also provide insight on peripherals that were being developed at the same period, even if the peripherals were developed by a different division. In the midst of a probe, another product may be discovered to be particularly important to the history of the company. Ideally, one might consider conducting another probe on that product. Otherwise, it may be possible to document it from existing information. Unless the other product was produced by a totally different organizational unit, or during a different period, the initial probe may provide enough information to locate records storage areas and to appraise the value of the records.

This new knowledge about the overall history of the firm may be used to complete a plan for documenting the entire company, which will conclude the fifth stage. The plan may call for

66 Discussion with Anne Millbrooke, Archivist, United Technologies, 1988.
other probes to be developed and implemented, or it may focus on particular documentary issues that must be addressed. Among these issues might be improving records management in the company, investigating better means of capturing machine-readable data, developing procedures for ensuring the preservation of ephemeral records (such as electronic mail), or donating important artifacts to a public museum. The probe might also bring to mind a series of short term projects, such as a historical exhibit, an oral history project, a written history, or even a conference. Of course, this plan will only be useful for an archivist or historian with a continuing relationship with the company.

The elements and sequences of stages for a documentary probe were developed during our work with the Control Data Corporation, and a case study of this experience follows. The development of the technique has also benefitted from our experience with other high-technology companies in the computer and chemical industry, and we are confident that it may be effectively used for the historical research of any high-technology company involved in the manufacture of products. It is likely that documentary probes could be used in companies that produce "intangible" products, such as services or software, but we have not investigated this use. Also, the probe's focus on products may not be suited to represent basic research conducted by a company. True basic research is not tied to a specific product, although, when successful, it may affect many products. A more appropriate way to develop information on basic research would be to conduct a probe of a specific project.

With the exception of basic research, products serve as the best foundation for a documentary probe of a high-technology firm. The same technique can be used beyond just high-technology industries; the only prerequisite would be appropriate modification of the description of industrial activity. Since the description in this guide was written in particular to accommodate high-technology companies, other descriptions need to be developed, particularly for non-manufacturing businesses such as banking, insurance, and finance. Similarly, we know that probes can be used in public sector institutions like government agencies, non-profit groups, and colleges and universities. As previously acknowledged, the probe idea originated with work relating the Department of Energy Laboratories conducted by the American Institute of Physics. Their probes were based on selected projects of the laboratories. Conceivably, projects could serve as the basis of probes in many government and academic environments.

67 Although not in the context of a documentary probe, Unisys organized a conference in 1985 of engineers and marketing representatives who worked with the Burroughs B-5000 computer. The result was an oral history transcript, portions of which were published in a historical journal.

68 Steven W. Usselman, who conducted research on the IBM 360 and served as a reviewer of a draft of this guide, commented that there are few products that move in a continuum from basic research to a commercial product. The most common starting point for a specific product is research and development.
A Case Study of a Documentary Probe

The Control Data Corporation (CDC) served as the focus of a documentary probe conducted by the Charles Babbage Institute for slightly over a year, beginning in 1987. This computer and peripheral manufacturer was formed in 1957 by employees who left the Univac Division of Sperry Rand Corporation. CDC grew from a group of a dozen employees to a large, multi-national corporation with the means to acquire an array of other data processing companies (over forty between 1963 and 1969). CBI considered the company an ideal setting for a documentary probe. First, the CBI staff was familiar with its executive personnel through previous studies and records surveys of Univac and Engineering Research Associates, where many of them had worked before joining CDC. Second, staff was familiar with the history of the company, which meant that the first stage of the probe, general historical research, was practically completed. Third, the company had established an archives and separate records management program, which could assist in locating materials and personnel. Fourth, CDC was willing to allow the CBI staff relatively unrestricted access to records and company personnel. This final element was critical to the success of the probe.

Recognizing that it was extraordinary for an on-going firm to grant open access to outside researchers, CBI was careful to inform company personnel about the purpose of its work and to protect the company's proprietary information. A description of the project was carried in the company newsletter, and a letter of introduction was available for employees who wanted assurance that the project staff had a legitimate "need to know." Though other CBI staff members were involved in the project, only Bruce Bruemmer and Sheldon Hochheiser interviewed personnel and conducted records surveys within CDC. Written reports and interviews that were circulated outside the company were made available for company inspection before public release.

When the plan for the probe was proposed to CDC, the staff felt that it was important to be as specific as possible. For this reason, the subjects of the probes were chosen before the company was approached. This situation limited the amount of time that the staff spent on general historical research (the first stage of a probe), but this was possible because the staff felt that it understood CDC's product line and its markets to some degree. Also, the staff had identified five criteria that would guide the choice of the products. First, the products should sample different time periods. Second, they should reflect different markets pursued by CDC. Third, the products should be important to the strategy of the company. Fourth, the products should be picked to reflect CDC's development from an entrepreneurial firm to a mature corporation. Fifth, the products should reflect CDC's interaction with academic institutions and government agencies.
Based on those five criteria, the staff selected the 1604 computer, the PLATO computer-based education system, and C-E-I-R, Inc. as the subjects of the probe. Although C-E-I-R is not a product, it was an example of CDC's strategy of acquiring companies to build expertise in different markets. It was expected that a product could be chosen from C-E-I-R that would serve as a probe for that company. Moreover, the staff was curious about the effect of acquisition on a firm's documentation (see the appendix for a discussion of acquisitions and documentation).

The 1604, introduced in 1960, was the first computer produced by Control Data and one of the first transistorized commercial computers. It was a technical and marketing success and established the company as a credible supplier of large-scale computers, a price/performance leader, and a significant competitor to IBM, Philco, and Sperry Rand in the high end of the mainframe computer market. It was marketed primarily to meet the needs of the scientific and engineering communities, and many of its first customers were agencies of the U.S. military. The 1604 was primarily responsible for the remarkable early growth of the company, which in 1960 was the archetype of the entrepreneurial computer firm. The 1604 was manufactured through 1967.

The Council for Economic and Industry Research, Inc. (C-E-I-R) was formed in 1952 as a business that applied analytical techniques to the solution of complex problems of government, science, and business. Based in Washington, D.C., it was an early leader in providing computer programming and other electronic data processing support. By 1962 it had two subsidiaries in England and Mexico, and eventually established data processing centers in Washington, New York, Cambridge (Mass.), San Francisco, Beverly Hills, Paris, London, and The Hague. By 1966 it had acquired a number of statistical and computer firms including American Research Bureau, Data-Tech Corporation, Computer Services, Automation Institute of America, and General Analysis Corporation. Among the company's developments were a scientific and technical information retrieval system for the U.S. Army, a large-scale electric load flow study for fifteen electric utilities, a network equivalent analysis program for the utility industry, a program for the IBM 704 that simulated the operation of an IBM 650, and decision-making analysis programs for legal clients. Before its acquisition by Control Data in 1967, C-E-I-R had expanded its business to include computer leasing and time sharing. Two years after the acquisition, most of C-E-I-R's operations were folded into existing CDC departments.

PLATO was among the first and largest computer-assisted education systems. Its development began in 1960 under the direction of Dr. Donald Bitzer at the University of Illinois. Between 1962 and 1966, PLATO was implemented at Illinois on a Control Data 1604 computer. In the early 1970s, the University of Illinois and Control Data entered into a research and development agreement, which led to a commercial version of Illinois' PLATO IV system (first marketed by CDC in 1974). CDC targeted educational institutions as PLATO's primary market, though industrial customers proved to be more profitable. The software was modified to make it compatible with new CDC mainframe computers. The first
version of the PLATO terminal was replaced by a cathode-ray tube terminal manufactured by CDC, and this model was upgraded a number of times. Sales of the system, which struggled during the late seventies, fell dramatically in the early 1980s after the introduction of the personal computer.

<table>
<thead>
<tr>
<th>Time Period</th>
<th>1604</th>
<th>C-E-I-R</th>
<th>PLATO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Markets</td>
<td>hardware</td>
<td>service bureau</td>
<td>software</td>
</tr>
<tr>
<td>Importance of Activity</td>
<td>first computer</td>
<td>significant acquisition</td>
<td>innovation in new market</td>
</tr>
<tr>
<td>State of Business</td>
<td>entrepreneurial</td>
<td>growing company with established market</td>
<td>mature company with decrease in established market</td>
</tr>
<tr>
<td>Interaction with other sectors</td>
<td>government academic</td>
<td>government academic</td>
<td>academic</td>
</tr>
</tbody>
</table>

Table 2. Characteristics of subjects for the Control Data probe

These three areas together met all five criteria, as seen in table 2. The subjects spanned the beginning of the company through the late 1970s and reflected three different stages of the company's development: entrepreneurial, a growing corporation with established markets, and a mature firm looking for new markets. They also followed CDC's participation in different markets, such as hardware, software, computer service bureaus, and educational services. The activities were clearly significant to the company. The 1604 was CDC's first computer product, and its success was responsible for the initial growth of the company. C-E-I-R, while not a critical strategic acquisition, added to CDC's growing market in data processing services and computer vocational training. PLATO was a premier computer-based training system that was favored personally by William C. Norris, CDC's founder and CEO. Finally, the three subjects of the probe involved interactions with the government and academia, both as customers and co-developers.

Once permission had been obtained from Control Data to commence the probe, the project staff proceeded to collect available background information about the 1604, C-E-I-R, and PLATO (the third stage of a probe). Because the general history had been sparsely researched, the staff concentrated on developing information on the three areas even before starting the interviews. This involved a literature survey of trade publications, technical
reports, newsletters, court records, and other documents that established a chronology of events and information about unusual aspects of the three activities.

Information about the 1604 was easily obtained because of its status as CDC's first commercial computer and the product that initiated the company's successes. While technical material was plentiful, information relating to the early organizational development of the company was not. Some information was obtained from testimony given in lawsuits, but the best sources were summary reports and other documents found in the corporate archives.

This was not the case for C-E-I-R. There were few records of any kind in CDC's archives, and only a folder of articles on C-E-I-R could be assembled from computer trade and the financial press. The most comprehensive source was a small collection that had been donated by C-E-I-R's president to CBI prior to the project. It was sufficient to assemble a chronology and some important names and products, but little else.

Information about the development of PLATO was easy to locate but more difficult to interpret. Articles about the system itself tended to report case studies of PLATO's educational use, and they were superficially informative about the system's development. The financial press was somewhat more useful because it was skeptical about PLATO's chances for success from the beginning, and this made the system newsworthy. The staff was surprised to learn that CDC's active role with PLATO began in 1973, far later than the initial investigation had suggested. Before then, developmental work had been conducted by the Computer-Based Educational Research Laboratory at the University of Illinois. Since PLATO was a relatively recent product, it was not surprising that the staff found only one published source that treated it as a historical subject.

While PLATO's contemporary nature complicated the task of understanding the system's history, it offered some new insights that would enhance information captured by the probe. First, it widened the time span of the probe and made it possible to develop information about CDC as a start-up business and CDC as a mature corporation. Second, it also highlighted the University of Illinois' role, which would permit a comparison of industrial research and development with development activity in an academic institution. Third, it offered insight to the difficulties in documenting a recent product whose life had not completely ended.

Although the selection of the three subjects was made on the best available sources at the time, the staff discovered that its information was not completely accurate. One aspect that the staff wanted to capture was the range of documentation associated with software, hardware, and computer services. PLATO originally offered promise as a case study of software development, but subsequent information revealed that most of the key development work had taken place at the University of Illinois.

C-E-I-R proved the least productive of the three probes, probably because it did not represent a single product. While it was chosen primarily as a case study of an acquisition, the staff also
had wanted to learn about its service bureau operations. As it became apparent that PLATO would not represent software development, there was hope that a C-E-I-R product might fill this role. Unfortunately, there were no sources of information at the level of detail that we needed for either the service bureau or software study. The C-E-I-R records required for such a study simply did not exist, and other sources were not informative enough. Such surprises are likely to be typical of any probe and are a strong argument for basing a probe on a series of product studies rather than just one.

During this point in the project there was sufficient information to commence interviewing. However, the staff decided to move into the fourth stage of the probe and turn its attention immediately to two large collections of non-current records -- the corporate archives and warehoused records stored by records management. This course was taken partly because the existence of "executive narratives" in CDC's archives made it possible to forego some of the initial interviewing. The narratives were written at the request of CEO William C. Norris in 1981 by the executive in charge of each business function in the corporation and ranged from straightforward chronologies to engaging histories of particular units. More importantly, they gave considerable insight into the industrial process at Control Data and developed much the same information that would be generated by interviews. An example of a typical narrative was written by Robert Schmidt, who became general sales manager of CDC in 1963. He describes the structure of the sales force for the 1604, individual large accounts, and the transition from selling the 1604 to the 3600 computer, which succeeded the 1604. He later recounts the acquisition of C-E-I-R and describes its attractiveness to CDC. The availability of the narratives reduced the amount of interviewing that the staff needed to conduct, particularly for the 1604, which was the focus of a number of the narratives. They were supplemented by the availability of oral histories that had been produced previously by the CDC archives staff. However, the oral histories were generally too broad in scope to be extremely useful.

Another reason for the staff's desire to examine non-current records was the enormity of the task. The sole method of retrieving records in the off-site warehouse was to scan manually over 12,000 pages of the master box list for certain number codes or obvious keywords relating to the 1604, C-E-I-R, and PLATO. Because this work needed to be conducted regardless of its sequence in the probe, the staff decided to take the opportunity while it was available. From this review, nearly 500 boxes of records were identified and examined. Notes from this activity were compiled and transcribed in a microcomputer file, and the data were transferred to a simple database program to ease access to the information. After this lengthy exercise we had more than adequate knowledge of the personalities involved, the key events, the interplay between development, marketing, manufacturing, and other industrial processes, and a number of unanswered questions.

There were obvious gaps of information in each of the three areas when they were compared to the range of activities in a business. For example, the records revealed little information about the sales process for the 1604. Likewise, there was little evidence of the development
and manufacture of PLATO equipment. This missing information was captured largely through a series of over thirty interviews of executives, managers, and other personnel. Most of the interviews were recorded, and a few were made a part of CBI's oral history collection. Though most were conducted in the vicinity of Minneapolis and St. Paul, one staff person spent a week at the University of Illinois interviewing staff of the Computer-Based Educational Research Laboratory and inspecting records relating to PLATO. A number of interviews were also conducted in the District of Columbia, the former headquarters of C-E-I-R.

As with all oral histories, the best interviews resulted from careful preparation. One interview concerned with the production of PLATO IST terminals was particularly worthwhile because the interviewees had access to a planning document that specified the production sequence for the product. The interviewee was asked to explain each of the steps and describe records that were created during the entire process. This led to a very complete picture of production at CDC during the late 1970s and of the records that would best document it. Such detailed analysis of industrial activity was not obtained in all of the interviews, especially those covering earlier events like the development of the 1604. However, better information was obtained when an interviewee could react to a document, or was asked to explain the sequence of activities in a particular business function. When such a sequence was established, it became easier to draw information about the creation of documents. For example, rather than asking one question about the records relating to marketing, the interviewers would attempt to have individuals describe the sequence of activities in marketing and, for each step, the types of records that were produced.

During and after the interviews, the staff analyzed information about sources of records, gaps in documentation for each of the three areas, and the suitability of the 1604, C-E-I-R, and PLATO as subjects of the probe. Apart from the records in the archives and records storage center, there were a few other sources for the 1604, mostly at CDC's Arden Hills, Minnesota facility (which is where much of CDC's hardware development and manufacturing presently takes place). Although the 1604 was not produced at this plant, many of the computer's technical documents were located there. Some of the engineers that had worked on the 1604 had brought a significant collection of records with them when the facility was opened. Of the three subjects, the 1604 was best documented in the company's archives. While hardware development was well documented, detailed information about software development and sales was not. There was a chance that records relating to 1604 software development still existed at CDC's West Coast facilities, but by all accounts they probably had been destroyed. Sales information was lacking because records from individual sales people either had not been created or had been destroyed at regional sales offices.

The staff uncovered no new sources of records relating to C-E-I-R before its acquisition by CDC; any records that existed at the company's headquarters in Washington, D.C., had been shipped to Minneapolis. Of the officers that the staff interviewed, only the president had retained any records. Most of the significant sources on C-E-I-R held by CDC related only
to the acquisition period. The remaining records did not allow the staff to follow any of C-E-I-R's products for the probe. As part of the probe, it was useful to have investigated the documentation produced (and lost) during an acquisition, but it would have been more useful to have followed a product rather than an acquisition for the probe. If C-E-I-R is typical of acquisitions in general, it suggests that documentation of such firms is in jeopardy. A discussion of acquisitions and documentation appears in the appendix.

The records of PLATO, unlike those of the 1604 and C-E-I-R, were found to be spread throughout the company. The staff believed that this was due in large part to CEO Norris' decision to have as many parts of the company as possible involved in the system's promotion and support. Most of the sources that the staff had located were concerned with the marketing and sales of the system in its various configurations. An analysis of the development of the system was limited to CDC's work in improving the PLATO terminal, and work at the University of Illinois, where most of the software and initial hardware development took place. The staff felt that PLATO's lack of success as a product could be attributed to problems with planning and marketing. These were adequately documented by records found in the records storage center, although more information was needed about the planning of the product by CDC executives. PLATO was an interesting part of the probe because its records were so pervasive. While this may simply be a symptom of a relatively recent product, it was also a sign of a growing bureaucracy at CDC.

The choice of the 1604, C-E-I-R, and PLATO was more than adequate to support the objectives of a probe. For each of the subjects, the staff was confident that important historical issues had been defined and that all remaining records had been identified. In just the ability to locate pertinent records, the probe was judged superior to a simple records survey. But the probe also proved its effectiveness in a number of other ways.

First, because the probe focused on the industrial activity, it revealed the effects of organizational changes and changes in business functions on the state of documentation in the company. For example, as the company adopted strategic planning or "phase product" reviews, the nature of planning documents changed. Similarly, as the company moved from an entrepreneurial firm to a mature corporation, some historically valuable records ceased to be produced as certain executives were given greater responsibilities. This was true of early sales reports, which became less descriptive as the company grew out of a simple, two-region sales operation. A comparison of corporate records produced during the development of the 1604 with those of PLATO illustrates the differences between the records of a start-up firm and a more mature firm. In 1960, it was common for memos and correspondence to move longitudinally across the corporation. At that time the corporate structure was simple and reporting lines were less rigid; CDC's small sales force often corresponded directly with President Norris. By 1975, CDC was a large corporation with a more rigid organization. The paper flow followed the formal hierarchy, and when memos moved across departments, all superiors were sent copies to avoid problems of protocol.
Second, the probe helped uncover important "lower level" sources. The records stored for headquarters' operations tended to document only the activity of high-level executives. Since the probe developed documentary information across business functions, it ensured that other perspectives were documented. As the staff began to conduct interviews, it discovered that middle managers gave more useful and detailed explanation of work flow and records creation than executives, particularly in research and development, manufacturing, and product support and enhancement. Often more complete documentation was available at this level. This was true, for example, of records relating to the PLATO IST terminal development. The Education Company, which had overall responsibility for PLATO, had documents of a very general nature on the terminal. The production people had kept the detailed specifications on the product and its production.

Third, the probe established a base of expert support for appraisal decisions and historical interpretation. Many of the individuals who had been interviewed for the probe represented the best sources of technical advice in explaining the content of certain records. For example, the manuals for the 1604 contained technical information that was well beyond the ability of the staff to interpret. One engineer who had managed the production of the 1604 was familiar with most of the documentation produced about the machine and was most willing to explain the purpose of each document and its relation to other documents. More importantly, he could explain what could and could not be learned from operation manuals, technical specifications, field manuals, and technical records. However, such individuals are not necessarily the best people to determine the ultimate historical value of such records. They may be emotionally tied to the product and give it too much historical importance. Also, they may not perceive the total documentary picture for a product, and can not appreciate some of the constraints on preserving and providing access to records. However, they usually can provide enough information to enable an archivist to make an informed decision about their value.

Fourth, other important sources of records outside of CDC were uncovered during the probe. A background search of the 1604 led to a contact with a professor at the University of Illinois who had saved an intact 1604 in his barn. PLATO was the subject of countless journal articles relating to computer-based education. Court cases such as Sperry Rand vs. Control Data, Control Data vs. IBM, and U.S. vs. IBM generated invaluable sources of information. The U.S. vs. IBM case contained a list of all 1604 computers produced and their owners. The staff discovered at Illinois an intact machine-readable file of electronic communications between the University of Illinois and the Control Data engineers working on PLATO; the company's file had been lost. One customer's relations with CDC during the early 1960s were documented in computer science department files at the University of Minnesota.

Fifth, the probe also addressed documentary questions about recent developments. The study of PLATO, which brought the scope of the probe through the 1970s, gave a good indication of the current types of records produced by the company. Such information would be impossible to acquire by analyzing stored records, simply because they would not be current.
The probe also explained the meaning behind past and current organizational changes in the company. Organizational charts may signal these changes, but they do not convey duties associated with offices or strategic reasons behind reorganizations. A Control Data organization chart from 1965 lists George Hanson as vice president of Corporate Marketing and James Miles as vice president of Marketing Development. Put in the context of the model of industrial activity, Hanson would be described better as director of sales, while Miles seemed to be in charge of international sales and served as a planner reporting directly to CEO William Norris.

One element of the fourth stage of our documentary probe was not implemented because it involved the acquisition of records, a task that was outside the scope of the project. However, recommendations on adding other historically valuable records to the CDC archives were forwarded to the company. Most of the records used to study the 1604 were already in the archives. This was not surprising since CDC's first archivist had selected the 1604 as an obvious product for the archives to document. The project staff augmented sources on the 1604, especially in areas like software for the 1604 and enhancements that produced the 1604-A. Unlike the 1604, few significant records relating to PLATO had been captured by the archives. The documentation of CDC's interaction with the University of Illinois was greatly supplemented by interviews. In some cases, records from the university were the only source of information about events that occurred at Control Data. In C-E-I-R's case, the most valuable records that were located by the staff were those related to the task force in charge of the acquisition. The only other possible sources about C-E-I-R were reports on individual projects for the government, and these, when they could be located, did not reveal much about the company.

Probably the best measure of success of a probe is in the fifth stage, which demonstrates how well a probe directs future archival and historical activities. The probe helped to identify other important products and events in Control Data's history. The probe revealed critical issues that did not necessarily relate directly to the subjects of the probe but were important to the general history of the firm. This information could easily guide future probes. Among these other issues were the development of the 3000 series and 6600 computers, Seymour Cray's influence on research and development, plasma display research as an example of an abandoned development effort, military systems work at CDC, strategic planning towards the end of the 1970s, software support for hardware products, and the establishment and growth of CDC's Education Company. While it might be easy to identify some of these issues without the aid of probes, it would not be simple to judge how well those issues were documented. A number of historical studies would have been possible based on the probe. No historical writing had been devoted to the 1604, even though it was the most thoroughly documented product in the company's archives. Similarly, the probe provided ample sources for a full history of PLATO and adequate sources for a study of C-E-I-R.

The probe revealed substantial information about the state of documentation in other areas. For example, the staff determined that it would be difficult to conduct a study of early
software development because most of the records did not survive the company's move out of Palo Alto. However, the study of PLATO revealed many sources that would support research of the CDC Education Company. The probe developed general information about the scope of the corporate archives, the extent and access to records stored by the company's records management unit, and the scope of technical material held at the Arden Hills facility. Future record surveys would benefit greatly from this information.

The case study pointed to some political factors that should be considered before undertaking a probe. Ideally, the choice of products for a probe should be made objectively according to the criteria presented in the guide. Realistically, most companies will favor the investigation of certain products over others. Some products may be a source of pride for company executives. At Control Data, the staff was certainly aware that the CDC founder would be happy with the choice of the 1604 and PLATO because they were a source of pride for the company. However, PLATO was not a financial success and the staff grew concerned when it began studying the later years of that product. After all, the project required that outsiders be given unrestricted access to records and individuals, and the staff did not want to endanger that privilege by drawing attention to unpopular events. Insiders involved in a documentary probe will not be immune to these political considerations. While it might be attractive intellectually to investigate an unsuccessful product, many companies would prefer not to stir memories of such products even if the study is conducted with the lowest of profiles. However, in many circumstances a disappointing or embarrassing product may be the best choice for a successful probe; certainly such an analysis might be productively used by the company to learn from past mistakes. Rather than avoid a failed product altogether, one should be prepared to present a compelling defense to study the product.

While the probe at Control Data was conducted over a period of a year, similar probes at other companies probably would take much less time. The two greatest variables are the scope of the probe and the amount of records that need to be examined. At Control Data, the staff was faced with a large collection of stored records for which there was little access by subject, and this situation considerably lengthened the study. On the other hand, the staff was not involved in many office records surveys. Unlike the CDC probe, other probes of high-technology companies will benefit from a completed description of industrial activity, which was being developed while the staff conducted the CDC probe. It is possible that a probe could be conducted in as little time as three months given the proper circumstances.

The reader may be surprised by the open attitude that Control Data maintained towards the project. In many ways CDC and its staff were remarkable for allowing a historian and archivist from a university to study the company with few restrictions. However, the staff does not believe that Control Data is unique in this respect. Probes can be valuable source of information about a company's history and documentation, and many companies would welcome help in preserving their history. This project demonstrates that it is possible for companies to support such work even when conducted by outsiders.
APPENDIX
The Effect of Business Acquisitions on Records

During the past several years, the subject of business acquisitions has received widespread attention from the press. It is not surprising considering that in 1985 there were over 3,000 mergers and acquisitions in the United States, and the level increased the following year. But the 1980s can hardly be called the decade of acquisitions; in 1970 alone there were 5,152 recorded mergers and acquisitions. Business acquisitions have been commonplace during the latter half of this century, and they are likely to continue. The level of this activity is certainly no less (and probably is more) for high-technology industries. In the computer industry alone, the size and scope of these business transactions have been significant. A list of computer companies or divisions that were purchased by other companies includes some of the most important players in the computer industry. Among general-purpose computer manufacturers there were Philco, Bendix, Daystrom, RCA, Raytheon, Computer Research Corporation, ElectroData, General Electric, and others. While some of these operations were not successes in the computer industry, their records are significant sources of information about themselves, their competitors, and computer technology.

Records of acquisitions are records in jeopardy. There are no special legal requirements that govern the records of acquired companies. According to Edward Rider, archivist for the Proctor and Gamble Company, the disposition of records is usually the lowest priority for lawyers and managers involved in negotiating the acquisition. Even legal ownership is often muddled. When a company acquires another, an agreement will describe the specific assets to be sold. Records are rarely mentioned but may be included in a standard clause that transfers ownership of "all such assets not mentioned."

Certain records are scrutinized prior to any acquisition. Usually when a company considers purchasing another, a special task force is created to assess legal and fiscal obligations that will be inherited by the purchaser. The task force surveys records relating to lawsuits, intellectual property, tax liabilities, accounting policies, employee contracts, benefit packages, lease agreements, and other long-term contracts. Stockholder lists also are examined. These records are likely to be transferred after an acquisition, though they rarely will be older than ten years. It is customary for a task force like this to develop a lengthy report on the

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70 From a presentation by Edward Rider at the Midwest Archives Conference, November 4, 1988.
prospective acquisition. After Control Data Corporation (CDC) evaluated the acquisition of C-E-I-R, the acquisition study "team" released a large report to CDC executives. The report included Control Data's objectives in buying C-E-I-R, the history of C-E-I-R, a list of direct benefits from the acquisition, a comparison of the market value of comparable companies, a financial review of C-E-I-R, and a strategy for merging C-E-I-R's operations into CDC. The assessment also contained candid reports from interviews of C-E-I-R employees and former employees. This is a vital record that documents Control Data's intentions. Reports like these should be preserved.

Yet the reports of acquisition teams cannot serve as a substitute for the full complement of a company's records. In most cases the core collection of records, including most historically valuable records, will be overlooked during an acquisition. The Computer Department of the General Electric Company provides a good example of the fate of the records of acquisitions. GE established its computer operations in the Phoenix area in the 1950s. Among GE's most successful efforts were the ERMA banking automation system, the 600 series computer (which was attractive to a significant number of IBM 7090/7094 customers when IBM introduced the 360), and time-sharing systems. Even so, progress in the marketplace was hampered by a number of factors, and GE's management felt that it could not afford to invest enough to make the company a contender in the computer industry. In 1970 it withdrew from the general-purpose computer market and sold its operations to Honeywell. Honeywell has since spun off its computer operations to a new company, Honeywell Bull.

Honeywell Bull's public relations department uncovered a newspaper clippings scrapbook and a film on computer manufacturing from the GE days but nothing else. Evidently, Honeywell had been pressed for space at one of its facilities containing a large collection of records. The result was that almost all records related to GE were disposed of at a landfill sometime in 1984 or 1985. There is a chance that executive-level records have been retained at the headquarters of General Electric or even Honeywell, but the core collection in Phoenix no longer exists.

The GE scenario is all too common in high-technology industry. There are no generally accepted practices with regard to the disposition of the records of acquisitions. Sometimes they happen to be saved; other times they are lost. However, there are situations when the records are more likely to be saved. First, the more central an acquisition is to the operations of the purchaser the greater the likelihood that the records will be saved. It is likely that Cedar Engineering's records remain intact because its acquisition formed the basis of Control Data's Peripheral Products Division. Second, records are much more likely to survive if they do not need to be moved. Engineering Research Associates records from the 1950s were found in 1986 in the same building that served as the headquarters of the corporation, even though the facility had passed through a number of mergers. Third, records will be less affected when a acquired company remains intact. This commonly occurs when a company's stock is bought out and it becomes a subsidiary of a conglomerate such as ITT, Litton Industries, or LTV. In such cases the records practices of the acquired company is likely to
remain unaltered. This was true of the Norwich Eaton Company when it was purchased by Proctor and Gamble.

None of the those three forces was a factor for C-E-I-R, which served as a case study of an acquisition for this guide. C-E-I-R, an early computer service bureau and software firm, was acquired by Control Data in 1967. While C-E-I-R remained a separate entity for a few years after the purchase, most of its operations were quickly folded into existing Control Data operations. Five years after its acquisition, C-E-I-R's records were shipped en masse to Control Data's central records storage facility in Minnesota, where they remained untouched until inspected by our staff. Among the records uncovered were complete sequences of monthly computer-printouts of a variety of ledgers, large quantities of duplicate payroll check stubs, many boxes of duplicate invoices filed by customer, and even a box of petty cash records, containing receipts for tolls paid by salesmen driving on the New Jersey Turnpike. There was no pre-selection of records; evidently, the company simply had to send all of the existing records somewhere. Most of the significant records in this shipment documented C-E-I-R's activities close to the time of the merger, especially those representing legal obligations assumed by Control Data. Virtually nothing from the 1950s, C-E-I-R's early years, had survived.

Interestingly enough, C-E-I-R itself was an aggressive acquirer of other companies. Few of these acquisitions were documented by the remaining C-E-I-R records. However, one company, Arbitron, had been kept as an independent subsidiary by both C-E-I-R and Control Data, and its records practices remained unaffected. This raised the possibility that the records of Arbitron might be a source of documentation for C-E-I-R, but no substantive records were located. It seems unlikely, though, that the records of a wholly-owned subsidiary would be useful in documenting its owner; most records sent from C-E-I-R to Arbitron would document only C-E-I-R's relationship with that one subsidiary. Since Arbitron's president served on the C-E-I-R board of directors, we had hoped that records pertaining to the actions of the board might have been saved by Arbitron.

The presence of a corporate archives program does not necessarily improve the situation for the records of acquisitions. Many corporate archives concentrate their work on the core of the business and ignore acquisitions that do not fit this framework. During the late 1970s, General Mills began to acquire an number of companies and product lines that were not food-related, such as clothing and jewelry. Because the acquisitions were subsidiaries and did not produce goods traditionally associated with General Mills, the archives chose not to acquire their records. Control Data maintains only marginal records on the acquisition of two early computer companies, Bendix and Librascope. An archivist at a large international conglomerate once commented that he had trouble locating the number and names of acquisitions, much less their records. Contrary to this practice is the policy of the Proctor and Gamble Archives, which does attempt to secure the records of acquisitions. One reason for this is that P&G's acquisitions have been directly related to consumer goods, its traditional market. Even under this policy, its archivist has not always been successful in acquiring the
records. As a matter of company policy, only those P&G employees responsible for negotiating an acquisition are allowed to contact personnel from the prospective acquisition while the take-over is being discussed. In some cases this has prevented the archivist from locating the records before they were disposed. \textsuperscript{71}

Mergers, divestitures, and product-line sales are similar to acquisitions in their effect on the preservation of business records. There are no general practices governing records disposition, and chance usually favors their being lost. Sometimes, mergers can have a positive effect on records, as when the archives at Kraft, Inc. expanded its influence and mission when Phillip Morris acquired the company and later merged it with General Foods. Conversely, the break up of the Bell System had mixed results. Much of AT&T's archives was consolidated with the archives of Bell Laboratories, and at least one of the regional companies, Ameritech, began to establish a corporate archives. But interest varies among the other regionals in preserving records from the old Bell System, and there is at least some evidence that valuable records were destroyed. \textsuperscript{72}

In some cases public archives can play a role in preserving the records of acquisitions or divestitures, particularly when the records do not adequately complement a corporate archives' mission. More likely, records of acquisitions and divestitures will find their way to public archives when the host company has no archival program or can no longer sustain one. The acquisition of Republic Airlines records by the Minnesota Historical society was made possible by the purchase of Republic by Northwest Airlines, which had no archives. Many of the records of Control Data Corporation came to the Charles Babbage Institute after the CDC archives was shut down, a victim of the declining fortunes of the company. None of these donations were made without the public archives having established a relationship with the company long before the records were donated. CBI had worked closely with the CDC archives (as this book attests) and the decision to offer the collection to CBI was nearly automatic. The moral for public and corporate archivists is to establish relationships before corporate change occurs and act opportunistically. Even having built relationships over a period of years, be prepared to see some acquisitions, mergers, and divestitures unravel those relationships overnight.

\textsuperscript{71} Presentation by Edward Rider at the Midwest Archives Conference, 1988.

\textsuperscript{72} During divestiture, an AT&T historian described to the CBI archivist a photograph collection that probably would be destroyed because the collection was in the jurisdiction of one of the regionals, and AT&T archives could not accept it.
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