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ORGANIZATIONAL INFLUENCES ON COMPUTER USE IN HIGHER EDUCATION

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Organizational Influences on Computer Use in Higher Education

Andrew Tyson Masland

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Abstract

Colleges and universities often have difficulty managing computer resources. Current reports and commissions make the same recommendations and reach the same conclusions that appeared a decade ago. The available literature provides, at best, confusing solutions to the problems associated with managing computers. It stresses structural solutions to computer-related organizational problems, including who controls the computer resource, where it fits within the organization, how it is allocated, and whether or not administrative and academic computing share facilities. The literature also decries the low level of computer literacy among students and faculty. My research suggests that organizational culture also plays an important role. It encompasses an institution's beliefs, saga, history, and symbols. The concepts of organizational culture explain much of the confusion in the literature and the continued problems with computer use in higher education.

Five colleges (Worcester Polytechnic Institute, Babson College, Simmons College, Regis College, and Wellesley College) illustrate the extent and nature of the mechanisms that link organizational structure and culture to computer use. At each site I interviewed administrators and faculty who have a role in computer management and use. Documents

and evaluations of computer use were another source of information. The three types of data provided information on the structure that supports computing at the institutions, specific aspects of the culture that surrounds it, who uses it, and why they use it. Each case discussion includes a summary of the key structural and cultural influences on computer use.

The thesis compares and contrasts the cases, and highlights similarities and trends among them. The cases illustrate the influence of organizational structure on computer use. Personnel, facilities, and allocation policy affect how campuses use computer resources. The role of organizational culture is also apparent. Each institution's saga, values, beliefs, and history influence computer use. Culture can support computing and enhance its development, or culture can frustrate efforts. Generalizations drawn from the cases suggest how colleges and universities might apply the research.

Chapter 1

Introduction

In 1981 students at Wellesley College and Regis College had difficulty using the schools' computer resources. While a large number of students attempted to use computing, competition among users restricted access. Faculty members at both schools did not give computer assignments because they knew that long waits for terminals frustrated many users. Students at these institutions were thus unable to take full advantage of an important educational tool. At first glance these two situations appear similar -- demand for a scarce resource exceeded the supply. But the underlying reasons for the problem were different at each school. It is to such differences that this thesis addresses itself.

There is little doubt that computing is a valuable resource for higher education. Soon after the general introduction of computers, a Presidential Science Advisory Committee (1967) established broad parameters and recommendations for their development and use. The Committee recognized that "Computing is a versatile tool useful in any work with factual or intellectual content" (p. 7). It defined minimum standards for all students in higher education. The

Committee felt that to fully exploit the value of computing "...students in colleges and universities must see for themselves what a powerful tool computing is, and learn to use it" (p. 2).

Awareness and use of computing's potential expanded as the resource became better known. Predictions of an educational revolution appeared (Carnegie Commission, 1972) and recommendations for the use of computers on the campus emerged (Levien, 1972). In the past decade computer use has grown. Between 1966 and 1976, the last year for which data are available, the amount spent on computing per student increased 238 percent, the number of computer installations on campuses rose 97 percent, and computer personnel increased by 106 percent (Alcorn, 1980).

Changes in technology have occurred at the same time (Gwynn, 1979; Swoyer, 1980). First generation machines of the fifties, which used vacuum tubes, were cumbersome to operate and far removed from the everyday world of most administrators and students. The second generation incorporated advances in solid state technology. Computers became more readily available to the nontechnical user. Technical progress continued with the introduction of integrated circuits which lowered costs substantially. Since that time clear delineations between generations have largely disap-

peared. But two trends are clear: hardware costs continue to drop while capabilities increase. The introduction of minicomputers and time-sharing have strengthened these trends. While advances in microcomputers are just being felt, their impact is certain. Microcomputers will further reduce costs and increase availability. Improvements in software (the programs that run on computers) accompanied changes in technology, further reducing the technical knowledge needed to interact with computers.

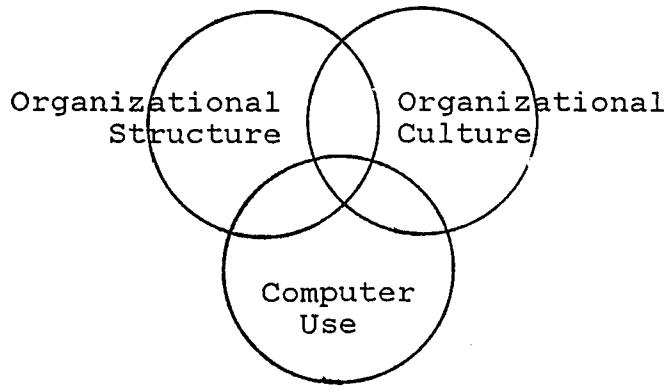
Computing technology and availability have progressed, but the development of the resource on the college and university campus has not met earlier expectations. Complaints about the current high level of computer illiteracy are widespread (Molnar, 1979; Luehrmann, 1980; Zinn, 1980). Commissions still discuss how to integrate computing into our educational system (Gillespie with Dicaro, 1981). Many of their recommendations are reminiscent of those made a decade ago. And many institutions face problems similar to those of Wellesley and Regis mentioned above.

Why is it that such problems still exist? One reason is clear. Management is always more difficult under conditions of uncertainty and change (Pettigrew, 1973). The past decade has been one of uncertainty for higher education in general. This is coupled with changing computer technology

and many administrators' lack of knowledge about computers. Management of computer resources in higher education has not received the requisite attention under these conditions.

Current literature on the management of computer resources focuses on structural solutions to managerial problems. These variables encompass formal systems of authority, responsibility, and control. But the literature offers no clear solutions and the suggestions it makes are not sufficient to solve the managerial problems associated with computer resources. This thesis introduces the concept of organizational culture as another influence on computer use in higher education. Organizational culture comprises the values, beliefs, and ideologies of those within an organization. The concept of organizational culture helps explain behavior under conditions of uncertainty such as those found within colleges and universities (Masland, 1981).

Organizational culture, organizational structure, and computer use all interact with each other. Figure 1.1 represents the model. This thesis investigates the extent and nature of the connections between the organizational factors and computer use. It demonstrates their influence on managing computer resources, and it suggests how administrators might use the concepts to understand and improve the



Intersecting Organizational Spheres

Figure 1.1

use of computer resources in higher education. While the concept of organizational culture illuminates both computer use and organizational structure, this thesis focuses on the interconnections between the organizational factors and computer use rather than those between culture and structure.

Chapter Two explores the concepts of organizational structure and culture as they relate to computer use. Chapters Three through Seven present five case studies. They describe computing at the research sites, and each concludes with a preliminary analysis of the important organizational characteristics. Appendix A compares the colleges on a variety of dimensions and Appendix B contains time lines of the major events at each site. Both are useful references while reading Chapters Three through Seven. Chapter Eight compares and contrasts the cases as they relate to the features

of the managerial landscape described in Chapter Two. It then discusses the findings in a more general fashion. Finally, it states possible implications for the use and management of computing at other colleges and universities.

Methodology

The thesis uses case studies to examine the mechanisms that connect the organizational factors and computer use. The case study method is appropriate for several reasons. First, I wanted to find and explore the relationships, not prove that they exist at all institutions. The research is thus exploratory in nature and a more extensive survey approach would not have been as effective. It would have been difficult to design a standardized questionnaire that would reflect the cultural differences among the sites. Interviews and observation are more appropriate methods for discovering the relationships I wanted to explore. More quantitative and extensive investigations would be possible in future research on this topic.

I purposely selected five institutions that use computer resources in different ways. Worcester Polytechnic Institute, Babson College, Simmons College, Regis College, and Wellesley College. Worcester Polytechnic Institute uses

computers in a technical environment. It views computing as a tool for engineering and applied sciences and as a subject of study. Babson College requires computer knowledge of all students. The institution sees computing as an essential part of management education. The college is also the coordinator of a regional computer consortium. Simmons College stresses the more practical nature of computing skills for its professionally oriented students. It recently developed an Applied Computer Science program. Regis College has done little with computing, but it is beginning to develop a certificate program for students interested in learning more computing skills. Finally, Wellesley College has integrated computing into its traditional liberal arts curriculum. It did this in a well planned manner and has carefully evaluated progress.

I selected these sites after reviewing college catalogs of schools in the Boston area and discussing possible sites with my advisor. I wanted a sample that would reflect differing types and degrees of computer use so that I could get a broader perspective on the relationships between computer use and the organizational factors. As is apparent in Chapters Three through Seven, the sites do, in fact, vary widely in their use of computing. The colleges also differ on a number of other factors (see Appendix A).

The sample clearly excludes several types of institutions. First, it omits colleges and universities with major research commitments. Federally funded projects require accounting policies -- and therefore structures -- which might obscure the effects of organizational characteristics (Kanter, Moore, and Singer, 1968; Office of Management and Budget, 1979). Second, it excludes large universities because they tend to have different computers for various segments of the institution. This complicates the organizational influence on computer use, not to mention the methodology required to describe it. Third, the sample does not include institutions which use specialized facilities instead of integrated computer resources. The problems associated with computer use, the original impetus for this work, are also more apparent at smaller colleges (Davis & Emery, 1978). This makes it more appropriate to concentrate on such institutions.

The principal method of data collection was semistructured interviews. I spoke with those directly involved in providing computer services, administrators, faculty, and users. I supplemented the interviews with document analysis. I examined official college publications and reports, internal documents, and reports of outside consultants. In addition, I reviewed information on computer use when it was

available. Appendix C describes my methodology in greater detail.

Chapter 2

The Managerial Landscape

This chapter describes the managerial landscape -- the ways of using, organizing, and controlling computer resources. It provides the reader with an overview of the literature which surrounds computer use in higher education. A basic understanding of the managerial landscape is important in relation to the case studies presented in this thesis or for understanding computing at any institution. The description of the managerial landscape will help the reader orient him or herself in relation to the use and management of computer resources.

The chapter first describes and classifies how colleges use computers. It then summarizes the literature on the structural aspects of managing computer resources. Finally, the chapter introduces the concept of organizational culture. Until now, this aspect of organizational behavior has not been applied to computer use and management. But as this thesis demonstrates, it plays a central role in understanding computers on the campus.

The managerial landscape is presented with one caveat: the use and management of computers are not stable over

time. Several stage theories describe how they change (Gibson and Nolan, 1974; Nolan, 1979; Robbins, Dorn, and Skelton, 1975). In these theories each stage reflects changes in use, organizational structure, planning and control, and user awareness. Introduction of computer resources occurs in the early stages of initiation and contagion (Nolan, 1979). Control and integration of the resource become more important as use expands. And when the organization progresses through the final stages, the key shift is from management of the computer to management of data or information resources. The technology takes on a secondary role. Robbins et al. (1975) note that institutions tend to move toward more complex and extensive computer resources. They state that once an institution begins to use computing, "it has set a chain of events in motion that brings increasing pressure to move the institution to the next higher stage of development" (p. 5).

Use

One reason for the changing nature of the managerial landscape is the great versatility of the computer resource. Our concept of what computers can do continues to expand and encompass new tasks (Robinson, 1981). The resource does

things better, does new things, and finally pervades and changes the entire way things are done (McCarter, 1978).

Because of the expanding and changing nature of computer use, a framework helps put it in perspective. One approach is to use a matrix that defines types of users and uses along one dimension and needs along the other dimension. There are two basic types of users, administrative and academic. The first group can include almost every administrative function on the campus, from admissions, registration, and alumni affairs to finance and physical plant. Information processing and record keeping are important applications. As users become more sophisticated, they may demand forecasting or simulation programs that aid in planning and decision making. Word processing is rapidly becoming another major administrative use.

Academic users include both research and instructional uses. Research applications now cut across the academic disciplines. Scientific use often takes advantage of the computer's ability as a "number cruncher" for complex calculations. Social scientists rely on computerized statistical packages for storage and analysis of their data. In the humanities, text processing applications such as content analysis, indexing, and searching are becoming more prevalent. And like administrative users, researchers make increasing use of word processing.

Instructional computing is the most varied application on the campus. A wide number of classification schemes are applicable to instructional use (Carnegie Commission, 1972; Zinn, 1980; Gillespie with Dicaro, 1981). One of the simplest is "tool, tutor, and tutee" (Taylor, 1981). Using a computer as a tool is very common. It includes the use of statistical packages for data analysis, simulation and gaming which enable the student to evaluate various theoretical or practical solutions to problems, and word processing. Using a computer as a tutor involves running programs that teach course material. This includes computer aided instruction (CAI), drill and practice, and question and answer tutorials. Finally, the computer can be a tutee. This is the most powerful teaching tool because in these applications students teach the computer how to do a task or solve a problem through programming. In order to do this they must thoroughly understand the subject matter themselves.

In addition to Taylor's three classifications, computers are the subject of study in computer science and engineering classes. They can also support other instructional activities by generating test items, controlling sophisticated media or laboratory equipment, or becoming demonstration media themselves.

Each type of user and use makes different demands of a computer system. These needs define the second dimension of the matrix (Mosmann, 1973; Robbins et al., 1975). Mosmann (1973) points out that in most cases users need services rather than specific types of equipment or facilities. Common needs include the capability to perform required tasks, special software, access to facilities, response time, reliability and predictability of service, security or protection of stored data and programs, and personnel support.

Users' needs can be mutually exclusive. Increasing access, for example, may decrease security. The largest difference in needs arises between academic and administrative users. Faculty and students require flexible and readily available resources, the ability to do lengthy calculations, discipline-specific application packages, and the capacity to deal with large data sets. Academic users also tend to put heavy demands on the system at peak periods such as the end of each semester or before large assigments are due. Administrative users, however, are concerned with scheduling, deadlines, security, and response time. They tend to run large jobs on a regular basis and must maintain strict schedules (Mann, 1979). Meeting the diverse needs of all computer users is a major task of those who manage computer resources.

Organizational Structure

A small body of literature has emerged to help the administrator better comprehend how to manage computer resources. The literature describes structural solutions to managerial problems. Such solutions involve formal systems of organizational authority, responsibilty, and control. Personnel, facilities, and policy for allocating the resource among users are the most important structural characteristics. The principal approaches to each are described below. While they are presented as distinct options, the approaches can be used in endless combinations to suit institutional needs.

Personnel. The major focal point of the structural literature is who manages the computer and where the manager fits within the institution. At a high organizational level responsibility can lie with a "computer czar" (Mosmann, 1973). Such an individual is an academic officer who understands technical issues but who is not a technician. The czar coordinates and controls all computer operations on a campus through control of computer policy and budgets. A vice-presidential title is possible, but even without the title a czar usually reports to the president. The position is more typically found at larger institutions.

Another possibility is a computer center director (Robbins et al., 1975). Such an individual, both a technician and manager, is responsible for the day-to-day operation of the computer center. At institutions without a computer czar, the director also serves as technical advisor to the administration for policy decisions. A computer center director can report to a number of positions including the president and either the chief academic or administrative officer. The primary distinction between a computer czar and a computer center director is that the former is usually placed higher in the administrative structure and has much less direct involvement in the daily operation of the computer center. A czar is an administrator for computing while a computer center director manages the resource, runs the computer, and advises decision makers.

Robbins et al. (1975) describe management by committee as an alternative to either a czar or computer center director. The committee's members can include individuals from all segments of the institution. While a committee may appoint a manager to handle the day-to-day operation, ultimate responsibilty lies with the committee. In this sense the committee is equivalent to the computer czar because it is responsible for policy and control but not actual operation. The committee approach may prove burdensome because

of inherent problems in the committee process: reaching consensus may be difficult, decision making may be slow, and one or two knowledgeable individuals may exert a powerful influence over the committee.

Committees are more commonly used in an advisory capacity. Two types exist (Cloward, 1971; Mosmann, 1975). The first, which advises a computer czar, consists of high level administrators and representatives of users. Its role is to review policy and planning. The committee provides powerful support for a czar. The second type of committee is a user's committee which meets with a director of computing to discuss common problems and needs. It is a means of two-way communication between the computer center director and users.

Two additional personnel structures are less common (Robbins et al. 1975). An institution can hire an outside professional team to manage equipment owned by the institution. Systems & Computer Technology Corporation (SCT) is one of the largest firms of this type. A college can also create a separate corporate identity to provide computer resources. These approaches place the burden of day-to-day management elsewhere and may resolve some internal conflicts over computing. But both approaches also present some new problems. Long-term commitments may limit flexibility and

remove some of the incentives for meeting institutional needs.

Facilities. The first technical structure is the centralized computer facility. In this situation one computer is available for all users on the campus. Such arrangements were common for second generation computers because of their size and expense (Robbins et al., 1975). Centralized systems are still found at many schools. Today centralized service may also support remote terminals or job entry stations at other locations on the campus. The major argument for centralized systems has always been that one system is more efficient to operate. Computing power follows Grosch's Law: the unit cost of computational power varies inversely with system cost (Mosmann, 1973). Roughly speaking, if System A costs twice as much as System B, it will be four times as powerful. Thus economy of scale is one of the key reasons for centralized operations. A centralized system also tends to provide greater personnel support for users. System programmers, analysts, and user support staffs tend to be more efficiently managed when centralized (Ralston, 1971).

As computers become smaller and cheaper there is a growing tendency for institutions to have decentralized facilities. Under such an arrangement more than one computer cen-

ter is available on the campus. Some critics feel that there is no real advantage in the economy of scale argument (Roberts, 1971). And faculty members who receive research grants may want to purchase their own computers. The advent of microcomputers promises to promote even greater decentralization of computer resources.

Perhaps the most pressing reason for decentralized facilities arises from the disparate needs of computer users. When administrative and academic users share one facility, the computer center may become the focal point for hostilities between the two groups. While technical problems do not preclude combining administrative and academic tasks on one system, they remain separate at many institutions. This issue raises stronger feelings than almost any other related to computer management on the campus. Each user group distrusts the other and often believes it is not receiving its "fair share" of computer resources. The merits of combining administrative and academic functions is still an issue of great debate (Mann, 1979).

The third technical structure is networking. This term has been used in many ways over the past decade, but here it is meant as the use of telecommunications to access a computer facility that is geographically removed from the user's institution. Under a networking relationship one

user or institution uses computer services provided by another institution, association, or commercial vendor. It has become increasingly feasible in recent years through advances in telecommunications. In many parts of the country, users may now gain access to a multitude of computers through a local phone number. Edunet is one example of a provider of such services.

For some schools networking is a low-cost means of providing basic computer services. It also can meet specialized needs (Miller, 1979; Mosmann, 1980). Institutions might use networking, for example, to take advantage of a specialized computer (a supercomputer for complex meteorological calculations) or computer package (EDUCOM's Financial Planning Model). Thus networking often supplements an institution's own computing resources. For many specialized users this is more cost-effective than purchasing a machine or software package.

Allocation Policy. Another issue in the structural literature is how to allocate computer resources among competing users. When there is an abundance of computer power available, allocation is not a problem: enough slack exists to meet the needs of all users (Nolan, 1979). When slack is not present, a common situation, control of the resource becomes more important and allocation is one means of exert-

ing control. Allocation policy is also a means of recovering the costs of operating the computer facility by charging users for the resources they consume. These two factors, control and cost recovery, are the driving forces behind allocation policy. But a stable allocation policy serves another functon as well. It is the user's guarantee of the availability and cost of computer resources (Mosmann, 1973).

Before describing various allocation methods, it is helpful to briefly review the computer resources they control: 1) central system resources including central processor (CPU) time, memory, and time required for input/output requests, 2) unit record peripherals such as card readers, punches, and printers, 3) data storage devices including disks and tapes, 4) terminals or ports (terminal connections), 5) personnel resources such as operator requests for tape mounts and printer paper changes, or analyst and programmer support, and 6) supplies (Bernard, Emery, and Scott, 1977).

The three basic methods of allocating computer resources are free access, restrictions on use, and chargeback. Free access is the simplest: its philosophy is that all users should have as much of the resources as they need. The institution carries the cost of computing as overhead. A free access policy is often justified in comparison to

library use. A library does not charge users according to the number of books they check out or the number of requests they make of the reference desk. If computing is an educational resource like the library, the argument contends, users should not pay for computer resources either. Furthermore, users may not know in advance the value of computer resources in their work. Because the value is unknown, they are unable to determine if charges for computer resources are reasonable; hence they will not take advantage of the computer facility (Luehrmann, 1973). Providing free access removes this obstacle.

As users realize the power of computing, they consume more of the resource. This problem leads to ever increasing demands on the system which can be met only through additional or more powerful equipment. If resources remain constant, demand will outstrip supply and users will not be satisfied. Once slack resources disappear allocation policy becomes "first come, first served" and free access no longer is a fair method of allocation. Users have no way of knowing what they can reasonably expect of the system, and managers have no means of controlling the resource.

The second allocation policy, restrictions placed on use, resolves some of the problems associated with free access. Under a system of restrictions users still receive

computer resources free of charge, but their access is limited in one or more ways. Users may be restricted to one or two hours of connect time, for example, if other users are waiting to get on the system. Other common illustrations are limiting each user's disk storage or restricting the amount of memory used during execution of a program. Another type of limitation is the use of priority categories. Under this scheme computer personnel can delineate various classes of users. High priority users might receive a greater share of central processor time, while low priority jobs might only run overnight or on weekends. Obviously, restrictions are on a continuum from less restrictive, such as limited disk storage space, to more restrictive, such as limited connect time. With reasonable limits users may still take full advantage of the resource. But the allocation policy gives them a better idea of the availability of the resource at the same time that it slows the growth of demand.

The third basic allocation policy is chargeback or making users pay for the resources they consume. Varying the cost of using different system resources controls demand: raising the price lowers demand (Nielsen, 1970). A chargeback system must meet several objectives if it is to serve its purpose well. The user must respond to it. A common

problem with chargeback systems is that they become so complicated that the user cannot understand how costs are derived (Nolan, 1977; Khtaian, 1975). The user should only pay for resources that are under his or her control. And the cost of running a particular job should not depend on characteristics of other programs that are running at the same time. Complex chargeback systems also make demands on system accounting programs, and thus may consume substantial portions of computer resources themselves. Government regulations concerning sponsored research may further complicate pricing structure (Kanter and Singer, 1968; Office of Management and Budget, 1979).

Chargeback structures also vary according to the specific methods of charging users. Charges can be in actual dollars. Each user, class, or department can budget a given dollar value to spend on computing. The user pays for the resources consumed. Such a scheme puts computing on par with other budgeted items. Administrative policy may limit spending to on-campus computing. Or it may permit users to spend funds for on-campus computer resources, off-campus service bureaus, or purchase of one's own computer. Budgeting in real dollars may be difficult for the computer center director, however. Most computer costs are fixed. Under such a scheme income depends on demand and thus may be unpredictable.

An alternative to budgeting in real dollars is to budget in another "resource unit" (McCredie, 1978). Under this scheme users receive internal dollars or a number of resource units used only for accounting and control. Users cannot trade "funny money," as such units are often called, for real budget dollars or non-computing resources. This method may not be effective if users treat funny money differently than other types of resources. But it still reminds them of the value of the scarce resource that they are consuming (Brink, 1971). Under this scheme the institution may calculate the computing budget separately, solving the problem of uncertain income for the computer center director.

Administrators may combine the different allocation policies mentioned above. Students may have free access to computer resources while faculty members with sponsored research pay through a chargeback scheme. Priority classes may restrict access, or they can be part of the pricing structure with users deciding to pay more for higher priority service. Restrictions may control access and a simple pricing scheme, such as charging for connect hours, may recover costs. Different organizational levels may operate under different allocation policies. An institution that participates in a network, for example, may pay for connect

hours and include that item in the institutional or departmental budget, but individual users may never see the connect hour charge and behave as if it were a free access system.

The final aspect of allocation policy is the question of who decides which allocation policy an institution should follow. Several possibilities exist (Nielsen, 1970). When viewed as part of the institution's educational philosophy, decision making at a high administrative level is appropriate. The global view allows consideration of overall organizational goals. But top administrators often lack the detailed technical knowledge necessary for such decisions. Users might like to make the allocation decisions, but they typically lack any objectivity. And the computer center director, who has both the technical knowledge and a sense of user needs, may lack perspective on organizational goals. Consultation among these groups or the use of an advisory committee often is the best solution.

Other Issues. No matter what the managerial configuration, evaluation and planning are common problems in managing computer resources. The fact that they often involve both technical matters and policy issues complicates their resolution. But effective evaluation does not have to be complicated. Measuring how long users must wait to get on

the system or how many jobs can run at one time are simple evaluation techniques. Monitoring performance to determine bottlenecks in the existing system configuration is an example of a more technical evaluation (Enger, 1976). Planning is closely related to evaluation. It is difficult to plan for future needs without first understanding current system performance. Evaluation and planning are technical in nature, but they also involve basic policy issues. The institution must decide what level of performance is acceptable and if expansion is within financial means or exceeds desired service levels.

Organizational Culture

The concept of organizational culture is the final aspect of the managerial landscape. It has recently received increased attention. Two episodes of the new public television series "Enterpise" have dealt with cultural influences on Japanese managerial practices, and Ouchi's Theory Z has been on the best seller list. Researchers have observed the influence of organizational values, beliefs, and ideologies on corporate policy and managerial style.

Culture helps an organization maintain its unique character. Ouchi (1981) states that organizational culture communicates beliefs and values which give meaning to life within the organization. Pascale and Athos (1981) describe organizational culture as a "bass clef" that conveys meaning to employees, as a "compass" that gives direction, and as the "shared values and spiritual fabric" that bind the organization together. They describe how an organization's culture helps employees know how to behave and make meaning or sense out of the behavior of others. It affects how managers perceive and resolve problems.

Precursors of Organizational Culture. Although not identified as such, the concept of culture has been implicit in the study of organizations for some time. Perrow (1979) describes the "institutional school" of organizational theory. This is associated with Selznick (1957) who differentiates institutions from organizations. The latter more clearly reflect a formal system of rules and objectives while the former are more a natural product of social needs and pressures. An institution is a "responsive, adaptive organism." Administrative ideologies and values produce a distinct identity for the institution. And institutional leadership defines a clear mission or goal that guides behavior. Through the process of institutionalization

values infuse the organization. It develops a distinctive character and takes on a life of its own. The institution becomes valued for its own sake (Perrow, 1979).

Research during the 1960s on organizational "climate" is another early indication of organizational culture (Tagiuri and Litwin, 1968). Climate is a measurable average of environmental characteristics or variables chosen for their relevance to human behavior. Research on higher education reflects efforts to quantify climate (Pace, 1968). A variety of scales attempt to measure institutional climate or the "atmosphere or style of life" on a campus. For example, the College Characteristic Index (CCI) measures environmental counterparts to personality needs; the College Characteristic Analysis (CCA), the College and University Environmental Scale (CUES), and the Environmental Assessment Technique (EAT) all measure demographic characteristics and elements of student subcultures. While applicable to many types of institutions, they are no longer widely used.

Harrison (1972) writes about organizational character, which is closely related to organizational culture. While not discussing "culture," he states that an organization's character arises from ideological issues. Ideologies are a central part of culture (Pettigrew, 1979). Harrison describes how values and ideologies aid in the understanding

of organizational behavior and conflict. He reflects the earlier concern for quantification, postulating four ideological orientations (power, role, task, and person). Harrison applies his classification to decision making, human resource utilization, and environmental interaction. His interest is in exposing organizational characteristics so that individuals can better understand the organization and potential sources of organizational conflict.

Pettigrew (1979) takes the final step and explicitly states that he is interested in a family of concepts called organizational culture. He defines culture as "the amalgam of beliefs, ideology, language, ritual, and myth." Pettigrew feels that these cultural concepts explain and prescribe behavior. He states that culture codifies meaning in a publicly and collectively accepted manner. Pettigrew places such great emphasis on culture because it is part of the longitudinal growth and development of organizations. He feels that examining past influences on organizational life aids in understanding the present and predicting the future. An organization's founder imparts direction and orientation through organizational culture.

Organizational Culture in Higher Education. The concept of organizational culture is also present in literature on higher education. Clear examples are seen in histories of

colleges and universities, especially those that are distinct. Duberman's (1972) discussion of Black Mountain College illuminates an institution that reflected the values and ideals of its founders and students, while at the same time it took on a life of its own. The culture that infused the organization greatly influenced its history and development.

Less extreme examples are apparent in the writings of college administrators on administration. Balderston (1974) devotes a chapter to the values of a college or university and how these affect the organization. He is concerned with academic freedoms to teach, learn, and speak. For the most part such values are commonly held in institutions of higher education and differentiate colleges and universities from business organizations. Eble (1978) also implies the value cultural concepts. His book, The Art of Administration, is a guide for academician turned administrator. It suggests that values and ideology are important in the governance of colleges and universities.

Clark (1971, 1972) provides one of the best applications of organizational culture to colleges and universities. He focuses on one aspect of organizational culture that he calls saga, a "collective understanding of unique accomplishment in a formally established group." The important

characteristics of saga are that it belongs to the group, it has a special meaning for them, and it provides a foundation for their involvement with the organization. The saga provides information about the culture or the institution's values, ideology, and beliefs.

Identifying Organizational Culture. Although the literature acknowledges organizational culture and its impact, concise means to define and measure it are not available. Students in an introductory sociology course have seen a definition such as "Culture is the realm of ideals and ideas, values and symbols...the design for living which produces a distinctive way of life" (Broom and Selznick, 1973, p. 52). Such definitions are the rule rather than the exception. Schwartz and Davis quote anthropologist Clyde Kluckholm's definition of culture as

> the set of habitual and traditional ways of thinking, feeling, and reacting that are characteristic of the ways a particular society meets its problems at a particular point in time (1981, p. 32).

In describing the culture of medical school students, Becker and Geer define it as "this body of understandings and agreements among students about matters related to their roles as students" (1958, p. 70). Common to these definitions of culture are concepts such as values, beliefs, and ideologies that are difficult to measure. But to dismiss

culture for this reason ignores the fact that it influences many aspects of organizational life. While culture resists measurement and codification, it is not that which cannot be measured.

The problem becomes one of making explicit the tacit and implicit values, beliefs, and ideologies that comprise culture. Means must be found to make it visible. The most commonly mentioned method is observation of behavior. Detailed observation over time and "thick description" illuminate culture (Geertz, 1972). Schwartz and Davis make it sound somewhat easier.

> All one has to do to get a feel for how the different cultures of competing businesses manifest themselves is to spend a day visiting each...there are characteristic ways of making decisions, relating to bosses, and choosing people to fill key jobs. These mundane routines, buried deep in companies' cultures, may be the most accurate reflections of why things work the way they do (1981, p. 30).

While it may be true that culture can be observed by spending time in an organization, it certainly is not the most helpful means of understanding the concept of culture.

A more helpful tactic is to examine manifestations of culture at work (Schein, 1981). From this evidence one can infer back to organizational culture. Pascale and Athos (1981) describe meetings as "cultural litmus tests" because

the effects of culture are readily apparent. Particularly in situations involving conflict, decision making, or change, one can observe culture influencing behavior. Patterns of behavior emerge from the stream of decisions (Mintzberg, 1979). The participants' reactions point to the underlying culture.

Saga, history, and symbols, are specific ways of uncovering organizational culture. Saga is important because it binds individuals to the organization. It structures their beliefs about the organization. It tells them what the organization values, what has meaning, and what is of special significance. Thus explication of an institution's saga is one method of exposing the underlying values and ideologies of the organization's culture. Clark (1971, 1972) describes five components of a saga's fulfillment. The saga must have the support of key personnel such as senior faculty; there must be distinct features in the college's academic program; there must be a social base of believers outside the institution, usually alumni; student subculture should support the saga; and there should be an imagery that strengthens the saga. Each of these five aspects can indicate the presence and strength of saga.

One criticism (Richardson, 1971) of Clark's concept and discussion is that while sagas may exist at small, unique

institutions, the concept may not apply to larger schools. Clark (1971) states that saga may become more diffuse in a large centralized institution, but within individual schools or units stronger sagas may develop. The bond exists with the smaller unit rather than the institution as a whole. Thus saga remains a valuable concept on many campuses.

Institutional history provides a second window on culture. History contributes to an organization's enduring value system (Pettigrew, 1979; Smith and Steadman, 1981). Examination of the organization's development often leads to discovery of the values and beliefs that shaped its growth. Sometimes these factors relate to the development of saga, but they give a slightly different view of culture when seen in the historical perspective. Discovery of institutional heroes (Deal, 1981) also illuminates organizational history. These are individuals who have been important in shaping the history of the institution. They may have made crucial decisions in time of crisis or upheld the central values and beliefs of the organization. Of particular interest in the current analysis is the history of computing at each research site and the identification of key individuals in those stories.

Symbols -- "something regarded as representing something else," according to The Random House Dictionary of the Eng-

lish Language -- provide a third perspective on organizational culture. Symbols are another means of identifying what is important to individuals (what they value) and how they view their world (their ideology). They communicate underlying values and beliefs (Ouchi, 1981). Strong feelings about the symbol, great elaboration around the symbol, or the symbol's use in many behavioral or systematic contexts signal its importance (Ortner, 1973).

Two types of symbols, summarizing and elaborating, are common. Summarizing symbols represent meaning in an emotional and undifferentiated manner. An example is the American flag. Elaborating symbols sort out complex ideas or feelings and make them comprehensible so that they can be communicated to others. This type of symbol can be conceptual, in which case it provides meaning through metaphor or myth. Metaphors help express what normally is inexpressible through the transfer of meaning (Ortony, 1975). Beaudoin (1981) uses metaphors to explicate differences among colleges. Her analysis of the metaphors that college presidents use to describe their institutions illustrates how to uncover the organization's values and ideologies. Elaborating symbols can also provide meaning through actions such as rituals. My examination (1981) of decision support systems in higher education shows how the concept of ritual provides

insight into these tools. Their meaning and use is more understandable when aspects of use are seen as ritual and the ritual is viewed as a means of expressing culture.

Application of the Managerial Landscape

The literature on managing computer resources focuses on understanding and controlling the technical and structural aspects of computers. This is understandable since early computer systems were remote from the administrator's world. As the cases that follow demonstrate, technology and structure still influence computer use. But the success of computers in higher education depends on both structure and culture. The cases illustrate the influence of the organizational factors on computer use.

Chapter 3

Worcester Polytechnic Institute

> A person who wants to work with tomorrow's technology needs the broadest education possible, because scientists and engineers touch upon an expanding variety of fields and areas of technology that we simply can't know about today. To deal with the important issues of technology, one must bring together knowledge, expertise, and -- most of all -- judgement drawn from all areas of life. These must be joined with a solid understanding of scientific and engineering and management principles.
>
> -- WPI Bulletin

Worcester Polytechnic Institute (WPI) is the third oldest engineering college in the country. Its first president toured Europe's finest technical institutes to find the best model for technical education. The school's motto, "Lehr und Kunst" or "Theory and Practice," reflects the institution's early concern for educating engineers and applied scientists. In the 1960s some individuals at WPI became concerned that the college's programs and graduates were too straightforward and rigid. Graduates were "narrow as pins" -- they only knew one specific field. The curriculum prevented students from evaluating or integrating course material. WPI also neglected the impact of technology on

society and vice versa. Graduates were often unaware of important societal issues that could affect their technical work. Finally, some faculty and administrators felt that WPI did not give enough attention to the students' personal growth and development.

A committee investigated these and other concerns. It evaluated the institution and suggested a variety of possible solutions. A proposal based on the British tutorial system received the widest support. After much debate the faculty approved the WPI Plan, as it became known, by a margin of two to one. The Plan requires that each student complete four primary degree requirements. First is a major qualifying project. This is an independent project conducted under the supervision of a faculty advisor. Second is an interactive qualifying project which examines the relationship of society to technology. Third is concentrated study in the humanities. Fourth is the successful completion of a week-long written and oral competency examination in the student's field of study. The Plan is a multidimensional approach to learning that retains professional competency while it allows personal development and a high degree of individual accountability.

The Plan required a radical shift in the institution's curriculum and structure. WPI received funds from the

National Science Foundation to help with its adoption. As part of the grant NSF required an evaluation of the Plan's implementation. WPI's success surprised David Riesman, a member of the evaluation team. He described the Plan as one of "extraordinary ambitiousness and scope." Riesman sensed that a degree of naivete prevented the Plan's proponents from realizing the scope of what they wanted to accomplish. Not knowing how difficult implementing the Plan might be, they went ahead and did it.

WPI has developed a new saga that centers on the Plan. The school's academic program and the adoption of seven week terms are distinctive elements of the saga. The majority of WPI's twenty-four hundred undergraduates understand the Plan's intent. The director of admissions describes these students as more independent, articulate, and diversified than students in the past. They are more similar to humanities students at liberal arts colleges than to their peers at other technical schools. Because of the project work, students develop close ties to individual faculty members. The Plan also fosters a strong bond between the institution and its alumni. WPI is developing a social base for its saga.

The Plan depends on WPI's 201 full-time and 46 part-time faculty. Each faculty member advises approximately fifteen

to twenty projects each year. Teaching is important, but WPI also rewards research and project work with students. William Grogan, the academic dean and a key figure in development of the Plan, finds that younger faculty members have the greatest difficulty adapting to the Plan. It is quite different from anything they have experienced in their academic careers. Grogan thinks that older faculty members help socialize the younger ones into the Plan.

Early Computing Efforts

There are ten colleges in the Worcester area. In 1969 the National Science Foundation gave WPI a grant to fund a computer consortium for local colleges. WPI was the leader in this effort because it had the technical expertise and need. WPI and Clark University became partners and founded the Worcester Area College Computer Center (WACCC). They purchased an IBM 360/40 and installed it at WPI. The arrangement was not successful from the start, in part because Clark remained WACCC's "poor cousin." The remote job entry station at Clark did not work properly either. Clark students had to drive to WPI and fight the "techies" to gain access. The necessary hardware and software were not available to simplify the problem. Thus Clark withdrew from WACCC in 1972.

WACCC faced another early problem. Within nine months it became obvious that the IBM 360/40 was not large enough to meet demand. At about the same time RCA announced that it was entering the computer field and that it would build a large plant close to Worcester. Discussions with RCA led to the gift of a computer. In 1973, however, RCA decided to discontinue its computer operations. WPI feared that within a year the RCA machine would be obsolete and spare parts impossible to find. Luckily negotiations between RCA and UNIVAC proved fruitful, and UNIVAC took over maintenance of the RCA machine. WPI installed a UNIVAC 90/60 in 1975 for both academic and administrative tasks. It continues to use the UNIVAC for these tasks. The 90/60 provides students with experience on an IBM-like system.

In addition to the uncertainty over RCA's future in computing, students only used the old RCA in the batch mode. This caused some limitations. Jim Jackson, the director of WACCC, also realized that the RCA machine could not meet all of the institution's demand for computer resources. He visited a number of other institutions in search of solutions to WPI's computing needs. A Digital Equipment Corporation installation at Cal Tech impressed Jackson. (This surprised him because DEC had not yet become a dominant force in minicomputers.) Thus in 1971 WPI installed a DEC-

system 10 for interactive academic use. WPI used the DEC-10 until 1980 when it replaced it with a DEC-2060 with sixty-four ports (terminal connections). The DEC-2060 is dedicated to academic use while academic and administrative users share the UNIVAC.

WACCC's primary function is to provide the necessary computing resources for WPI's needs. The college budgets computer resources as overhead, as it does with library expenses. Jackson attempts to make the resource available to the largest possible number of users. He sets the rules and attempts to be fair to faculty and students. He tries to meet faculty needs and stay abreast of state-of-the-art developments. Because WACCC's primary mission is to provide computer service, Jackson does not feel obligated nor does he have the financial resources to provide personnel support for all applications and languages.

Jacskson reports directly to WPI's president. He is a computer center director because he is directly involved in managing WACCC. For academic computing Jackson relies on one full-time and one half-time staff members, plus two student assistants. The senior staff member deals with questions, problems, and requests for additional disk space. Four operators keep both machines up 24 hours a day. Jackson would like to hire more students for handling tasks such

as I/O requests on the UNIVAC. He would also like a "smart kid" from electrical engineering to help with telecommunications, modems, networking problems, and so forth. Unfortunately, Jackson finds that most students do not need the money and if they are any good they probably already work at Digital Equipment Corporation part-time.

Jackson also works with an advisory committee. It consists of faculty and administrators who have an interest in computing. The committee considers computing issues that affect the entire campus. Recently, for example, it has discussed the possibility of introducing networking that could link WACCC's facilities with other small computers at WPI. The committee is a high level policy and planning committee, not a user advisory board. This approach is consistent with WPI's relative lack of direct user support.

In addition to terminals at WACCC, the center supports five remote terminal areas. These are convenient for students and faculty, but Jackson finds it difficult to manage them. He cannot provide staff and complete documentation for each remote area. It is also harder to spread the load over the remote sites. When all of the central terminals are busy, for example, students may not know that the remote areas are free.

WPI follows a free access allocation policy with one exception. Each student only receives 200 blocks of disk storage. There are no signup sheets for terminals. If a student is playing a game, however, another student can ask for the terminal. Jackson believes that students can learn a great deal from writing computer games, but he restricts game playing to certain times of the day. In general, he supports any student use of the facility because he thinks that if students are using the computer they are learning. Word processing is also available, but it is restricted to the least busy times of the day and thesis paper is only mounted on the printer at night.

Approximately one thousand students use the college's central computing facility during each seven week term. All students must complete a required programming course, and thirty to forty percent become very adept with computers. The Computer Science Department is not the biggest academic user. Most other departments use a wide variety of application packages, although there is less computing in the humanities than at some liberal arts colleges. There is little active encouragement for faculty to develop computer resources, yet faculty members are innovative in their computer assignments. Younger faculty know computing. Students often push older faculty members into computing

because faculty do not want to appear ignorant to their students. The institution does try to keep faculty up to date. Several faculty members, for example, are currently at Digital Equipment Corporation to learn some of the latest advances in computer circuitry.

Administrative Services at WACCC

WPI hired Jackson as administrative data processing manager the day it purchased the IBM 360/40. In that role he provided "start to finish" services for other colleges and universities which needed administrative computing. WPI needed computer resources that could handle demanding academic tasks, but it did not need such resources full-time. Thus outside contract work produced additional income to support WACCC. At one time thirty-five schools used WACCC's services. That number has decreased to twenty. Because of a recent IRS ruling WACCC's contract income will no longer be tax exempt because WACCC makes a profit on its outside activities. But even after taxes WPI will still profit from the contract work.

When WACCC began operation, the school's business manager declined to become involved. He thought he was doing a good job with administrative computing and was concerned

about security on a shared system. WPI's president, however, began hearing reports from other institutions that used WACCC's services. He was impressed with what he heard, so in 1970 moved all administrative computing to WACCC. At that time he made Jackson the director of WACCC, and the former director became head of the new Computer Science Department.

WACCC has much greater staff support for its administrative functions than for academic users. Six programmers deal with specific administrative offices. One lead programmer-administrator, and two junior programmers provide support for the outside contract work. WACCC also employs six data entry clerks. Jackson and his staff have developed all administrative software. It has evolved over time as hardware and needs have changed.

Jackson believes that joint operation is financially sound because the two groups share the costs of facilities and personnel. Some members of the academic community accuse Jackson of favoring administrative users. He does spend a good deal of his time on administrative tasks including developing and maintaining outside clients. Jackson, however, feels that academic users do not need much support because they are technically competent. Criticism from academic users have not influenced WACCC's operation.

It is likely that dissatisfied users will seek other sources of computing.

Proliferation of Computer Resources

Three to four hundred students enroll in the Computer Science Department's introductory programming course each term. This placed a large load on the UNIVAC, and teaching FORTRAN via batch processing had also become unacceptable. The DEC-2060 was not capable of handling the load. Thus the Computer Science Department recently obtained a Data General NV/8000 computer that supports 24 interactive users and PASCAL (which will replace FORTRAN as the required language). The department considers the NV/8000 to be laboratory equipment dedicated to a special purpose. It is entirely responsible for operating and maintaining the system. Neither the head of Computer Science nor Jackson is sure how the arrangement will work in the long run.

The acquisition of the NV/8000 illustrates the tendency for individuals and groups at WPI to obtain their own computer resources. This is due in part to funds they receive for research and in part to the technical orientation of the college. Mechanical engineering, for example, buys Apples "left and right" for their graphics capabilities. As long

as additional computers do not duplicate WACCC's services and funds for ongoing support are available, WPI encourages this tendency. Administrators try to ensure that departments do not enter into too many expensive service agreements. But departments make the purchase decisions. There is no overview or control of the process of proliferation. Jackson's advisory committee is only concerned with computer purchases and policies that affect the entire campus.

Despite proliferation Jackson feels that the need for WACCC remains. In addition to more extensive capabilities, it provides central storage facilities, input and output devices, and other peripherals. If the campus network becomes a reality, WACCC will be able to provide these services to all users. It is not clear at this point what the decentralization of facilities means for the management of computer operations at WPI.

Summary

Computing is a natural part of the technical environment at WPI. It is all pervasive and the value of computing is obvious. The institution needs computing resources to support its curriculum. This was the driving factor behind the development of WACCC and the proliferation of computing on

the campus. Because computers are widely understood the school has not struggled to integrate computing with its course offerings.

Jackson assumes that in a technical environment he does not need to provide a great deal of user support. This hinders computer use by those in nontechnical areas. But even some faculty members who are knowledgeable about computing wish that WACCC provided more user assistance. WACCC is well established in the service bureau mode, however. Jaskson feels WACCC exists to provide computer resources for WPI. He does not believe he is obligated to do much more. The lack of active encouragement might be responsible for the slow development of computing in nontechnical departments.

Jackson's position verges on becoming a computer czar, but he does not control WPI's computer policy and budgets. It is doubtful that he will gain such responsibility. The institution is not interested in controlling proliferation and does not have any one in a position to do this.

Chapter 4

Babson College

> I have always refused to go into an activity which somebody else is already carrying on satisfactorily. It may be true that pioneering is an expensive luxury, but...the world...benefits most when you do something new or when you do it better or differently. I am most interested in developing a new race of business men.
>
> -- Roger Babson

> Our only assurance of continued success is to continue to pioneer.
>
> -- William Dill

Roger Babson's sentiments still direct the college he founded in 1919. The saga Babson developed provides a foundation for the institution. Administrators and faculty know the college's strengths and act accordingly. The school strives for excellence in select areas -- management education for tomorrow's business leaders -- rather than adequacy in many areas. Its academic program is derived from this goal.

When founded the Babson Institute offered a nine month business certificate. Tuition was high, but Roger Babson was sure of his market and confident of what he was doing.

The Babson Institute added a three year bachelor's degree after the Second World War and a masters program, which replaced the certificate, in the 1950s. In the late 1960s the school had difficulty marketing the three year degree and was not attracting the desired number of women and minorities. Thus the institute changed its name to Babson College and adopted a more traditional four year program in which forty percent of a student's courses are business-related, forty percent are in the liberal arts, and twenty percent are electives.

During the 1970s Walter Carpenter, a long-time member of the faculty and academic vice-president, devoted much of his attention to gaining a more secure place for the college in the academic community. He led the successful efforts to gain accreditation from the American Assembly of Collegiate Schools of Business (AACSB). Babson was the first school of business which is independent of a larger college or university to receive such accreditation. Faculty and administrators remember Carpenter's efforts. They respect his concerns for the college and the quality of the management education it provides.

Students at Babson mirror the institution. The fourteen hundred undergraduates and eighteen hundred MBAs are interested in business careers and know that Babson provides good

preparation for this goal. The undergraduates tend to be more concerned with their career goal than students at other colleges. The director of admissions feels that while not more intelligent than peers elsewhere, students are motivated, willing to do what is relevant to their goals, and demanding of the faculty. Many students come to Babson from families with business backgrounds and many plan to return to a family business. Roger Babson told graduates of the nine month certificate program that they had paid their dues to the institute and that he expected nothing more from them. The four year program has prompted stronger ties between alumni and the college. The school has paid close attention to this shift and it is now drawing upon alumni for greater support.

Babson College emphasizes teaching. Administrators stress the importance of excellence in the classroom. Babson's 117 faculty (93 of them full-time) understand and respond to this challenge. Faculty members tend to involve students through cases, simulations, and discussions. The college sometimes has difficulty recruiting faculty "superstars," but the institution is attractive because it encourages faculty to become involved in private business and consulting. In fact faculty members can spend a day and a half each week engaged in outside activities. Faculty often

integrate such experiences into the classroom, making courses more interesting and current for students.

There is common agreement that Babson's administration reflects the mission of the institution. There is an attempt to "practice what we preach -- good management." Faculty and administrators think the organizational structure is relatively efficient. This is reminiscent of Roger Babson who was straightforward and utilitarian. The administration also projects traditional "yankee conservatism." The college does not borrow money except for dormitory construction. Babson has not run a deficit since 1929. Jesse Putney, the financial vice-president, firmly believes that the college never will run a deficit. (Putney's father held the same position before him.) The organization is small enough so that administrators can work closely together. They also use the faculty's business expertise when appropriate. Marketing faculty have researched external factors that influence the college, for example.

Administrators pay careful attention to the Babson College Master Plan. Revised yearly since 1968, the Plan states the college's mission and goals, who is responsible for reaching each goal, and how to meet them. While the Plan may reflect current practice more than future goals, many administrators turn to the Plan for guidance in setting goals and performing their jobs.

There are two new voices at the institution. Babson inaugurated President William Dill in the fall of 1981. Melvyn Copen, the administrative vice-president, has only been on the job nine months longer. Putney is certain that both will quickly fit into Babson's conservative financial mold, learning to say no with a smile rather than placing the college in an unsound fiscal position. Dill is ready to build upon the college's saga. He recognizes its strengths; the centrality of excellence in teaching management education, the emphasis on relating studies to the world of work, and the school's favorable orientation in the educational market place. He also knows that Babson must be good at what it does because there is no special magic about a Babson degree -- management education is not a prerequisite for success in business. Dill wants to take advantage of a successful fund raising campaign and strengthen Babson's special niche in the world of higher education.

Babson: An Early Leader in Providing Computer Resources

As early as 1962 a Babson course talked about computers, but it was not until 1967 that a course actually used computer resources. In 1968 the faculty decided to add computing to the curriculum in a more formal manner. The Math/

Science Department hired Edgar Canty to direct academic computing. That spring he taught a small faculty seminar to introduce available computer resources and the BASIC language. Babson installed two terminals and contracted with a commercial time-sharing operation. Beginning in the fall of 1968, a noncredit programming course became a requirement for undergraduates. The next year Canty added another terminal, and contracted with ten suppliers to provide computing for the campus. The multitude of systems proved troublesome, however, because of different procedures and data requirements. It also became clear as the year progressed that computer use and cost were increasing in a linear fashion.

Canty soon realized that he could not provide the needed computer resources within given financial constraints. Thus early in 1970 Babson's president sent invitations to administrators at forty-five local institutions, asking them to attend a meeting if they were interested in sharing computer resources. As a result of this effort, six colleges founded the Academic Computer Group (ACCOMP). Babson agreed to underwrite the risk and bought a sixteen user Hewlett-Packard 2000A on a five year full payout lease that could be cancelled at the end of each year. Schools paid a flat fee of $2,700 a year for each port (terminal connection) they

leased from ACCOMP. This covered the cost of the machine and Babson's overhead including centralized staff. As part of the agreement ACCOMP's members actually bought equity in the computer. Originally this was based on the percentage of ports they leased over the life of the computer. Eventually ACCOMP changed the equity share to reflect the percentage of total cost each school had paid. When the equipment is sold the members receive their share in the equity or invest it in new equipment.

The ACCOMP approach appealed to Babson for several reasons. First, with ACCOMP its computer resources cost half of an equivalent amount of commercial time-sharing. The school could not have provided the computing it wanted without ACCOMP. ACCOMP's pooled resources provided more computing than each school could afford individually. Second, the agreement committed the institution to a lower fiscal risk than the previous arrangement. Third, Babson had funds in its reserve accounts to finance the HP2000.

The growing financial implications of computer-related decisions and the move to ACCOMP made Canty's boss, the chairman of Math/Science, somewhat anxious. He had neither the interest nor background to cope with such problems. Thus Jesse Putney, the financial vice-president, agreed to become responsible for academic computing and approve all

computer-related decisions. Although not familiar with computers, he saw the business implications of the matter and made the necessary decisions fairly easily. He relied on Canty for technical advice and recommendations. Putney saw the financial advantages of ACCOMP and simply followed what seemed like a reasonable, business-like approach. He considered computer expenses to be part of the college's overhead, as were costs associated with the telephone system, copy services, and postage.

Canty became director of ACCOMP. He was responsible for

Year	Members	Number of Babson Terminals	Babson's Percent of ACCOMP Terminals
1970-71	7	3	30.0
1971-72	11	5	26.3
1972-73	12	6	33.3
1973-74	13	6	30.0
1974-75	12	10	41.6
1975-76	7	15	57.7
1976-77	9	25	74.2
1977-78	9	39	51.3
1978-79	N.A.	N.A.	N.A.
1979-80	N.A.	N.A.	N.A.
1980-81	N.A.	70	80.5

ACCOMP Membership and Terminal Distribution

Table 4.1

finding schools which were interested in joining the association. Some years this took considerable effort. But ACCOMP's success grew over time (see Table 4.1). Since 1970

forty institutions have participated in the association. ACCOMP was a reasonable approach to computing for these institutions because it offered the resource at a fixed price and did not represent a long term commitment.

ACCOMP's facilities also expanded. In 1972-73 ACCOMP upgraded the Hewlett-Packard system to a HP2000C' with thirty-two ports and additional memory and storage. But the HP2000 series did not support FORTRAN or COBOL and the machine was becoming obsolete. Thus in 1976-77 the association purchased a Digital Equipment Corporation PDP 11/70. ACCOMP members were concerned that it was more computer than they needed, but within a few months Canty had assigned all the ports and doubled memory and storage.

Although Babson is only one member of ACCOMP, the arrangement looked like a centralized facility to Babson users. Canty performed the duties of a computer center director. The Master Plan stated that the computer center was a "widely available resource for learning (and that it) should provide computing capabilities to meet demonstrated need." Furthermore, the center was "to meet the needs of the curriculum, faculty, research, and administration." Canty interpreted this as providing requested resources within reasonable limits. Canty and his staff reacted to faculty requests, but they usually did not take the initia-

tive in providing new services. Canty attempted to meet with faculty to determine their needs and provide information about resources currently available.

Packages such as statistical programs and simulation models are the most heavily used computer applications at Babson. Faculty and students also do some programming. The noncredit introduction to programming became part of the required freshman calculus class. MBAs had to take a noncredit computer course. Students had free access to the system on a "first come, first served" basis. While they had limited disk storage space, the policy was liberal and tape backup was readily available for those who needed it. A faculty committee met infrequently to discuss computing needs. Its major accomplishment was a recommendation concerning the number of terminals it thought would be needed in the following academic year.

Management Information Systems at Babson

At the same time that Babson formed ACCOMP, it also attempted to found an administrative computing consortium. It designed the Inter-Collegiate Computer Society, Inc. (ICSI) to provide services similar in nature to ACCOMP but for adminstrative users. ICSI struggled from its incorpora-

tion in 1971. Local colleges were not interested in the arrangement. There were many reasons for this, but prominent among them was the fact that computerized administrative systems need to be up and running before they replace manual systems. Institutions did not want to invest in developing programming, and satisfactory software was not on the market at that time. Thus ICSI disbanded in 1975.

During this period Babson had several batch administrative systems that were not terribly effective. High level administrators did not take any actions to alter the situation. But the admissions office, for example, used the HP2000 in an under-the-table fashion. The director of admissions relied on Canty and his staff to provide assistance when they had time to do so. Other ACCOMP members used the HP2000 more extensively for administrative tasks. Babson's president was embarrassed to learn that these systems were better developed than those Babson used.

Thus in 1974 Babson hired George Dixon as registrar, with the understanding that he would also develop an information system for the college. The registrar's office was a primary user of an ineffective batch system so it was a logical place to begin design of the new information system. Administrators entertained a proposal for separate administrative and academic systems but rejected it as too costly.

Thus they decided to treat administrative computing as another ACCOMP customer. ACCOMP would act like a service bureau for administrative use and lease ports as needed. Dixon worked with administrative offices one by one. He had the advantage of not having to redesign old batch systems in most cases. Babson went right to an interactive time-sharing system. All offices now use common data bases, data element names, and command structures to facilitate the sharing of data and personnel. This is a change from the previously independent data bases. One of Dixon's major tasks was the training of clerical and administrative staff.

Dixon became the director of management information systems in 1978. He reports directly to Putney. Dixon still relies on Canty for computer resources and operating the system. They work closely on many issues. Dixon also works with an administrative advisory committee that sets priorities and monitors progress. The committee discusses issues such as what data to archive and how best to do this. Dixon tries to educate the committee members, vice-presidents and deans, about technology and how to manage it.

Despite some initial problems, Dixon's efforts are going well. Administrative offices are pleased with the system but are looking forward to improvements and new applications. An issue of principal concern is word processing.

Babson has a small word processing center. It has trouble meeting demand, however, and it is not tied into the central data bases. Dixon hopes to remedy this situation and make word processing an integral part of administrative computing.

Expansion of Computing Facilities

In the 1978-79 academic year Babson received a substantial gift, a VAX 11/780, from Digital Equipment Corporation. ACCOMP also sold the obsolete HP2000. Thus the college had a VAX and a PDP 11/70. In previous years Canty found that it was difficult for students to learn two operating sytems and protocols. Canty and Dixon were also increasingly concerned about the security of administrative data as the management information system expanded. After the installation of the VAX, Canty decided to consolidate all academic computing on the VAX and administrative computing on the PDP 11/70. ACCOMP members still use the PDP 11/70.

Other computer resources have also expanded. Babson's new library houses thirty terminals and more are scattered around the campus. The college also provides two portable terminals that commuter students can use at home. Students can use word processing programs and a letter-quality prin-

ter. (Several faculty members estimate that about one-quarter of the students prepare papers on the computer.) Projection devices make on-line computer demonstrations possible in five classrooms.

The computer center staff has grown over time. In addition to Canty there is a coordinator of user services, a user programmer, and a manager and operator for each system. Arthur Mann, the coordinator of user services, oversees twelve student assistants who are available seven days a week to answer students' questions. Mann gives the assistants on-the-job training. Unfortunately, there is a large turnover in the positions. The pay is low and other students make great demands on the assistants' time. While on duty they sit outside the computer center and wear a blue lab coat so they are easy to identify. But if they become known as computer assistants, students tend to stop them whenever help is needed, even if the assistant is off duty.

Freshmen at Babson must still take introductory computing. In the fall of 1981 a new course, Introduction to Information Processing, replaced the introduction to computing in calculus. Faculty members felt computing took too much time away from calculus and they wanted to add topics such as FORTRAN, COBOL, editors, and file management. MBA students must also reach a minimum level of computer proficiency.

All departments except the liberal arts use computing in at least one class. Faculty view computer resources as tools to help the student understand underlying concepts. The computer is primarily used for data analysis, and probability and statistics. Other uses are application packages in the various business disciplines.

Although all students must meet a computer requirement, many still face problems when using the computer for other classes. Faculty members notice a bimodal distribution of students. Some are extremely comfortable with computing, while others still have anxiety and frustration -- they do assignments but with a great deal of struggling. In some cases anxiety may result from the amount of time between the students' introduction to computing and their next class that uses the resource. There also is a tendency among students to view the computer as an end in itself rather than a tool. Faculty report that they fight this and that it may be caused by the student's lack of familiarity with the resource.

Not all faculty require computer use so the students' exposure depends on who teaches their section of a course. The total amount of computer use has continued to increase over time, as demonstrated in Table 4.2, but penetration has declined. Fewer courses use computing today than did sev-

Year	Connect Hours
1973-74	16,000
1974-75	23,000
1975-76	32,000
1976-77	N.A.
1977-78	38,000
1978-79	43,000

Babson College Connect Hours

Table 4.2

eral years ago. In the 1973-74 academic year, 33 undergraduate courses used computing. This decreased to 23 courses in 1978-79 and dropped to 17 last fall. Thus students are using computing in fewer and fewer courses.

Mounting Crticisms

President Dill's inaugural address made it clear that he expects the faculty to use computing resources.

> Babson has made a fine start (with computing). But there are new horizons. More courses should draw on the computer to explore the implications of theory, simulate consequences of choice, and bring new scope and sense to the analysis of data. What lends urgency to our efforts is the advent of small personal computers and the reasonable expectation that they will soon become as much a part of a student's baggage as typewriter and stereo. Faculties have little time left to lead. Soon they will struggle to catch up.

Many faculty members agree with their new president. But some do not think that there has been enough support for the development of computer resources. Others feel that the computer center is under staffed and that salaries are too low to attract or retain good personnel. They also feel that Canty has not taken the initiative in making new packages and facilities available. Some faculty feel that Babson should make every effort to lead collegiate computing and that Putney has not allowed this because of his tight fiscal policies. More critical faculty feel that the computer center has been grossly mismanaged. There is a perception, for example, that the computer center staff do not provide adequate maintenance for the VAX which increases "down time."

Such criticisms have, in part, been responsible for the recent revitalization of the faculty computer committee. The new chairman of the committee has expanded its membership to include students and a consultant from Digital Equipment Corporation. In the committee's advisory role it makes recommendations to Canty about needed services, facilities, and application packages. But the committee is often at odds with the computer center director. It faces a basic problem -- one of clout. "We must holler loud and long," one committee member says, "to get what we want." It has no

direct influence because Canty reports to the financial vice-president not the administrative vice-president.

The hierarchical structure developed, in part, because the former academic vice-president had little interest in computing. He was satisfied to have Canty report to Putney. Putney has told Copen, the new academic vice-president, that he will give him responsibility for the computer center whenever asked to do so. The chair of the faculty committee thinks this will happen soon. Copen is less certain. He knows he should take it on, but he is too busy with other matters at the moment. If and when the reorganization takes place, Copen will be comfortable with the role. While Putney relies heavily on Canty's expertise and admits that he knows less about computers than he should, Copen has previously managed forty-five federal computer centers.

Another problem facing Babson is the recent decline in ACCOMP membership. Babson now uses over eighty percent of ACCOMP terminals. Institutions have left ACCOMP because they have become more sophisticated in their use of computing resources. It has also become easier to purchase and operate computer systems. ACCOMP's decline has removed an important source of revenue for Babson's computer operations. Babson faculty have come to expect an adequate supply of computer power. ACCOMP provided the funds for this.

Without ACCOMP's financial support Babson will have to spend more if services are to remain constant or expand.

Canty is now responding to faculty criticisms. He has drafted a proposal that would place the computer center in a more proactive stance. He wants a careful study of Babsons's future needs for computer literacy and development of additional seminars for faculty. At the same time, however, he must do this with decreasing support from ACCOMP. It is not clear how he will resolve this dilemma.

Summary

Past decisions at Babson clearly influence the current computer operation. The faculty's early push for a freshman year computer requirement fueled the original development of computer resources. Their interest is not surprising in light of Babson's values. They wanted to provide the knowledge and experience necessary for "tomorrow's business leaders." The faculty still strive for this goal. As their awareness of computing increased, so did the scope of the computer requirement. It now incorporates new technologies and approaches to computing. BASIC programming no longer suffices.

Babson's computer requirement and the use of computer resources as tools in the business environment follow from the institution's saga. Computer knowledge and skills are a necessary part of the education Babason strives to provide. President Dill's restatement of the computer literacy goal has reinforced the value of computing at Babson.

Computing has also served a symbolic function at Babson. In the past the college has been a leader in providing computer resources. It follows Roger Babson's directive of "pulling the cart, not riding in it." For several summers Babson provided computer resources free of charge to five local communities. The publicity the college received demonstrated its ability to lead and provide the necessary resources for its students. Some members of Babson's faculty think that the school is no longer demonstrating such leadership.

Babson's facilities are still centralized. Although Babson is a member of ACCOMP, its computer resources appear like a centralized facility to users. Canty and his staff still manage both administrative and academic facilities. Canty is not interested in microcomputers at this time because he feels the college has enough resources to meet current demand. A few faculty members have begun using microcomputers, however, and Babson's new president certainly recognizes their importance.

The institution's decision to found ACCOMP provided relatively inexpensive computing for growing needs with little risk. ACCOMP's financial support enabled Babson to develop computer resources to meet faculty and student demand. Users learned to expect ample resources, however, and now Babson faces the problem of providing a sophisticated level of service with diminishing outside support. High faculty expectations are, in part, responsible for recent criticisms.

Because of the organizational hierarchy, many faculty feel that financial considerations still take precedence over educational policy. The decision to have Canty report to Putney made sense at the time it was made and it was congruent with the college's established administrative procedures. But conflicting values -- financial conservatism versus educational leadership -- are clearly opposed to each other in the current problems facing Canty and others at Babson.

Chapter 5

Simmons College

> It is my will to found and endow an institution to be called the Simmons Female College, for the purpose of teaching (those) branches of art, science, and industry best calculated to enable the scholars to acquire an independent livelihood....
>
> -- John Simmons, 1867

Simmons College remains true to the mission John Simmons stated over a century ago. The institution, which opened its doors in 1902, still stresses career preparation for women through a balanced combination of professional and liberal arts education. Simmons College has a strong saga. Faculty, administrators, and students are aware of and believe in the college's mission. They know what makes Simmons different from other women's colleges. While many schools now offer career programs in response to the demands of today's students, Simmons has always believed in career preparation tempered with a degree of reverance for the liberal arts. The college's academic program supports its saga. A Simmons education aims beyond vocationalism to preparing the student for a meaningful life.

A major reexamination of the college's mission occurred in the 1960s. Simmons undertook a self-study in light of changes in American society and the needs of women. Faculty and administrators remember the devotion and concern for the college J. Garton Needham demonstrated as the college undertook the self-study. Needham, a long time faculty member and administrator, played a key role in the process. The college devoted several years to the task, formed many committees, and consulted with many experts. The final outcome of the self-study was a report whose objective was to "restate (Simmons') educational philosophy in contemporary terms" (Report of the President, 1964-1965). The report recommended a major structural reorganization to combine separate professional schools into divisions of Humanities, Sciences, and Social Sciences. This further integrated the liberal arts into the professional curriculum. Finally, the committee encouraged implementation of a previous decision to award the Bachelor of Arts instead of the Bachelor of Science for most majors.

Although the college's mission is still strong, maintaining its devotion to John Simmons' will has not always been an easy task. Some tension between the professions and the liberal arts has always existed. The tension, reflected in reaction to the self-study and its outcome, is sometimes

problematic but often creative, prompting new ideas, courses, and programs.

Simmons' nineteen hundred undergraduates reflect the college's saga. Simmons' director of admissions describes them as goal oriented, responsible, down to earth, practical, and solid scholars. Perhaps less philosophical than students at more strictly liberal arts colleges, faculty members feel that the students know what they want from Simmons and they work hard to attain it. Separate offices of career counseling and placement aid students in their search for employment. Alumnae retain a strong bond with the college. The exact reasons for this are not entirely clear. It may be the school's small size, that it is a women's college, or it's ability to deliver on its promise of career preparation. But whatever the cause, alumnae remain involved with the school.

Teaching is the primary concern of Simmons' 167 full-time faculty. They are interested in their students and develop close working relationships with them. While they pursue research, publish papers, and work in the community, teaching is most important. Faculty and students cite former faculty members such as Wylie Sypher and J. Garton Needham as examples of faculty who met the Simmons' ideal and who inspired others to do the same. The faculty do, at

times, feel the tension between professional and liberal studies. But despite departmental rivalries for students and funds, common to many campuses, faculty report that they work well together and maintain close informal ties with each other and the administration.

It is commonly acknowledged that President William Holmes and Administrative Vice-President Priscilla McKee retain most of the power in managing the institution. The president supports and encourages the efforts of faculty members and administrators, but final decisions are usually made in his office. Despite the centralization of power, administrators work on an informal basis, shunning memos and written reports in favor of conversation among themselves. Administrators also reflect the institution's interest in working closely with students to meet their needs.

The college has operated without a deficit since 1970-71. It did suffer an erosion of its applicant pool around 1975, but applications have increased and, according to the president's wishes, the freshman class has grown in size. The school's ratio of matriculants to accepted applicants has also increased. The college has successfully completed a large capital campaign and thoroughly renovated the main college building. It was recently reaccredited for the maximum ten year period. In short, Simmons has a strong

sense of itself and its place in the educational realm. The school also has the determination to accomplish its goals.

"Supermarket" Computing

President Holmes recognizes that computing is a current technique and language, and that it is a valuable "window on the world." He supports the efforts of faculty to introduce computing into the curriculum. In the late 1960s Simmons offered one FORTRAN course. Through faculty interest and initiative in many departments, this evolved into a number of computer-related courses and courses that use computer resources. Beginning in the fall of 1981 Simmons offered students a major in Applied Computer Science. The story of the development of computer resources is an interwoven tale of equipment, people, and policy decisions.

Early interest in computing at Simmons developed slowly. In 1968 the Department of Mathematics introduced FORTRAN. The course relied on batch computing facilities at the Massachusetts Institute of Technology. A year later Leonard Soltzberg arrived at Simmons as an assistant professor of chemistry. He had used computers in his graduate training and was interested in acquainting Simmons students with computer resources in a nonthreatening manner. The chairman of

the Chemistry Department agreed, and together they convinced the president to support the effort with a modest budget of about two thousand dollars. Soltzberg offered a noncredit course, Computer Appreciation, for students and faculty who shared his interest and enthusiasm.

The college's early efforts used a terminal made available at a discount rate through NERComP, a regional association that sells and leases equipment, provides consulting services, and facilitates networking. Simmons purchased computer resources from a commercial time-sharing vendor in the Boston area. Simmons was not interested in buying expensive computer equipment. It realized, however, that the cost of commercial time-sharing was too high. Thus Simmons was interested in Babson's efforts to develop ACCOMP and the college became a charter member of the association. The college also maintained its relationship with NERComP and so had access to a variety of computer systems in the New England area.

In 1970 President Holmes asked Soltzberg to chair the faculty computer committee. This group met to discuss the college's computing needs and how to meet them. It was a natural means of managing computer resources because the college had little equipment. The committee still includes faculty from each department that uses computer resources.

The president appoints members, choosing faculty with an interest in computing. The committee operates by discussion and consensus. It produces an annual report summarizing computer use at Simmons, but no one keeps minutes of the committee's meetings.

The committee's presence generally is not felt beyond the user community. The committee's primary function is to ensure that Simmons makes optimal use of its computer resources. Its role is more than advisory. The committee provides informal leadership for computing at Simmons. Its duties include disseminating information about available computer systems and software, planning computer-related curriculum changes, and reviewing budgets for expenses associated with computing.

Both the committee and departments budget computer costs. The committee is responsible for budgeting the fixed computing costs -- the costs of terminals, telephone lines, supplies, and membership dues. Departments budget the variable computing costs -- charges for connect hours and disk storage. Each department produces its computer budget in close consultation with Soltzberg and the committee. Once the president approves the budgets, all computing funds are placed in one account. Soltzberg oversees these funds, pays all expenses, and informs each department of its charges.

If one department overspends its computing budget, Soltzberg can use funds that another department has not spent.

Simmons' networking arrangements satisfied the college community. Soltzberg appreciated the wide variety of resources made available at a cost of only fifteen-hundred dollars. He thought of the college's facilities as a computing "supermarket" where users could find something to meet all of their needs. Through ACCOMP and NERComP users could access a Hewlett-Packard 2000F, an IBM 370/168, a dual-processor Honeywell 635, and a Digital Equipment Corporation PDP 10. Soltzberg felt blessed by these resources and by not having to deal with the problems associated with managing the day-to-day operation of a computer facility.

Over the next five or six years, interest in computing at Simmons developed slowly. Soltzberg's course became a half-credit course and eventually a full-credit course. As use expanded, the college's administration realized that management of computer resources required greater coordination. Thus President Holmes formalized Soltzberg's role in 1976 and appointed him coordinator of academic computing in addition to chairman of the computer committee. Soltzberg is still active in these roles and reports through Vice-President McKee to President Holmes. Soltzberg's original responsibilities were those of a computer center director

with an important exception. He was not responsible for a computer facility. Rather he handled problems with telephone lines and terminals, maintained contact with ACCOMP and NERComP, and directed users to the system that would meet their needs.

Since 1979 eight student computer consultants have relieved some of Soltzberg's duties. They are responsible for monitoring terminal use, keeping signup sheets current, replacing ribbons, posting notices, and maintaining an adequate paper supply at each terminal. They are also on duty seven days a week to assist students who have problems with the computer assignments. A student can reach the consultant on duty by calling the campus security office which, in turn, contacts the consultant with a paging device.

Competition among users is the primary restriction on computer resources. Students may reserve one hour time slots at a terminal, and when their time is up another student may demand access to the terminal. Soltzberg routinely and "ruthlessly" polices disks to make sure that students are not using excessive storage. Both students and faculty may request extra disk space if they can document their need. In all other respects allocation is free access.

The Simmons College Computing Facility

As academic computing advanced, administrative computing lagged. Offices that were computerized used outside service bureaus. Each administrative unit maintained its own information base which it did not share. In fact, Simmons had contracts with many different service bureaus. The system provided service that was neither timely nor cost-effective. The president realized that something needed to be done, so in 1978 he hired a consultant to study the college's needs. The consultant recommended moving to an in-house system and hiring a firm to help decide what kind of equipment to purchase, to design a management information system, to write needed programs, and to manage the operation of the computer facility.

As discussions with the consultant progressed, administrators did not consider combining administrative and academic computing operations. Holmes had a "positive bias" against joint operation. He viewed the two tasks as being quite different in nature and did not want to face the problems of giving preference to one group over the other. From previous experience on another campus, he felt that academic use would begin to take precedence over administrative computing. Faculty were also wary of combining academic and administrative computing. They believed that one user group

would squeeze out the other, but they assumed administrative computing would gain control of a joint system. Thus caution on both sides and a general satisfaction with academic computing meant that discussions advanced without consideration of combining operations.

Simmons hired the Systems & Computer Technology Corporation (SCT) to establish its administrative computing facility. (SCT is one of several large firms that manage computer facilities and provide administrative software for colleges and universities.) Simmons' next task was the purchase of a computer system. Holmes feels that SCT pushed for larger systems than Simmons needed. With cost a primary consideration, Holmes and SCT finally agreed on a Hewlett-Packard 3000 Series III. The machine was larger than what Holmes thought the college needed, but it was SCT's first contract to work with a minicomputer. All of the firm's previous clients had owned larger systems.

The college's experience with SCT was not, on the whole, a positive one. Although administrative computing has progressed considerably, Holmes feels that SCT lead the college down the "primrose path." SCT had to start from scratch with many of the administrative programs because of the minicomputer configuration. SCT personnel were alienated from the administrative offices and turnover was high among

SCT's staff. Administrative users were not satisfied with the operation and were frustrated by continual delays. They felt the results certainly did not justify the costs.

In December 1980 Simmons did not renew its contract with SCT. Holmes felt that the college could achieve better results in a more cost effective manner without SCT. He asked Soltzberg to take over as part-time director of the administrative facility. Thus Soltzberg became a computer center director with managerial responsibility for the college's computer facility. Other staff members include an assistant director, a senior programmer, two junior programmers, an operator, and a data entry clerk. The past year was one of "smoothing out" operations and solving problems that remained. Administrative users are still not totally satisfied, but it appears that progress has been made. The president remains optimistic that improvements will continue and user satisfaction will increase.

Because the HP3000 was a larger system than originally anticipated, Soltzberg realized that it could meet some academic computing needs. He dedicated seven of the system's thirty-one ports to academic use. The system is the primary resource for students taking the FORTRAN and COBOL programming courses. These are the two largest academic user groups and account for approximately seventy percent of all

academic computing. Because the resource is already provided for administrative users, the president felt that there was no need to charge academic users. In the annual computer report, however, use is rated at five dollars per connect hour. Holmes and Soltzberg think that this is artifically low, but they want to encourage use. The joint use of the HP3000 has not caused any major problems to date. This may be because Soltzberg directs academic and administrative tasks and both user groups respect him highly. The groups know that sharing the system will eventually cause difficulty. But it is a problem they have yet to face or solve.

Terminals to access the college's computer resources are located in the HP3000 facility in the main college building, in the science building, and now in one of the dormitories. The last location makes it much more convenient for students to work at night. Students use the same terminals to access all of the computer resources available to them. The computer committee has increased the number of terminals as demand warranted (see Table 5.1).

The college has also acquired several microcomputers over the years: the Psychology Department obtained two small systems dedicated to data collection, the Physics Department uses microcomputers for laboratory and experimen-

Year	Connect Hours	Number of Terminals
1972-73	1,448	3
1973-74	1,670	3
1974-75	1,847	4
1975-76	N.A.	N.A.
1976-77	2,673	5
1977-78	3,939	9
1978-79	2,820	9
1979-80	3,943	9
1980-81	5,802	19

Simmons College Connect Hours and Terminals

Table 5.1

tal use, and the library purchased an Apple computer for student and faculty use. The computer committee purchased another Apple at the request of a mathematics professor who had seen a microcomputer demonstration at a professional conference. This machine is kept on a special "Apple Cart" which the media center maintains and schedules. Faculty can have it set up in their classrooms. All interested parties discussed the purchase of the microcomputers with Soltzberg and the committee to avoid duplication of effort and because Soltzberg is the knowledgeable individual on the campus.

Consolidation of Computer-Related Courses

Simmons developed a variety of computing resources over time. Use has increased slowly (see Table 5.1). Mathemat-

ics and Chemistry Departments teach programming, and the Physics Department offers courses on more technical matters. Computing also supports other courses. A Sociology course uses a statistical package for data analysis, and Biology, Chemistry, and Mathematics courses use packages to help students master basic concepts.

Computer use has developed from faculty interest and initiative. There has been no formal means of encouraging computer use on the campus other than the limited influence of the committee. Simmons depends on individual efforts and the expertise of faculty members, especially Soltzberg. He has encouraged others to become involved. An "osmosis effect" is present and computing is slowly diffusing among the faculty. Among the primary faculty users are those whose graduate training included learning about computer resources. The computer committee has offered a few seminars on microcomputers, but it is too early to determine faculty response. Top administrators support the faculty's efforts, but they have not actively encouraged computer use.

In general, faculty are content with computing at Simmons. They realize that all wants are not within the realm of budgetary possibility. Additions of a software package, more terminals, or a microcomputer for a particular department are the major wishes of faculty, but these are not nec-

essities. Students can gain exposure to computing in a number of settings. Many experience the anxiety associated with new users learning to deal with computer resources. While the inaccessibility of terminals at the end of the semester as many students rush to complete assignments frustrates users, they understand the value of learning about computing.

Computer use expanded at Simmons although there was no sequence of computer courses for the interested student. The faculty committee was aware of this shortcoming for several years. Discussion of integrating the computer offerings had usually appeared on the committee's agenda once a year, but without results. During the 1980-81 academic year the discussion finally gathered momentum. The committee designed a major which applies computer science to other disciplines.

Two faculty coordinators now direct the Applied Computer Science program. The actual sequence of courses is still undergoing some revision but will include programming and technical courses, applications, independent study, and a course on technology and society that places computer use in a broad perspective. The student can major in Applied Computer Science and minor in another discipline that uses computer resources, or vice versa. The program gives the stu-

dent an appreciation for computing in her chosen field. Simmons wants to educate women who will understand both fields and act as a communication link between the two. When the faculty committee designed the new program, it produced one that strictly adheres to the philosophy of the institution. Applied Computer Science marries professional studies with the liberal arts.

Currently there are seven programs that students can combine with Applied Computer Science. In order to qualify the other department must have some computer-related courses, a faculty member with knowledge of computing to act as a liason, and someone willing to sponsor independent studies (all Simmons seniors undertake an independent project). Faculty have debated which majors can be combined with Applied Computer Science. The desire of the Management Department to become an approved co-major caused some discussion, for example. There were several points of contention, but primary among them was the computer committee's concern that Applied Computer Science and Management would be too professional in nature and would not include enough liberal arts. This debate, which has yet to be resolved, illustrates the strength of Simmons' saga and its affect on decision making.

There are several reasons why the Applied Computer Science program coalesced when it did. The committee realized the need for a more coherent program, it knew that computers had become ubiquitous and students should be knowledgeable about them, and it was aware of the declining high school student population and increasing pressures on the admissions office. It also recognized the demise of the Physics Department. The department consists of one faculty member, and it never attracted many of the more practically oriented Simmons students as majors. Applied Computer Science would do this and meet a variety of outside demands. Thus the program emerged from the interest and expertise of the faculty committee. The dean of science suggested putting it before the entire faculty for a vote right away and it passed with little trouble, which is unusual for a new major.

The faculty committee realized that the Applied Computer Science program would make new demands on the available computing resources. Students needed a system that they could control. They would need to experiment with the operating system, for example, which would interfere with the needs of other users. The college purchased a small (four user) PDP 11/34 with the help of a discount from the Digital Equipment Corporation. Students are responsible for running the

11/34. They will design the operating system, perform back-ups, and take care of all the other chores associated with a small machine. The faculty committee oversees the operation and one of the Applied Computer Science Coordinators is responsible for maintenance.

Summary

Several key decisions shaped computing at Simmons. The first was to obtain computing through ACCOMP and NERComP. Simmons was not tied to one system and could take advantage of many resources. Soltzberg is still pleased with the practical image of supermarket variety and value. This image is consistent with the practical nature of Simmons' approach to education. But the variety of computer resources means that users have to stay in close contact with Soltzberg because he is the one individual who can direct them to the resources they need. His individual attention remains a necessity.

The second decision was to purchase the HP3000 for adminstrative computing and hire SCT to develop administrative systems. While the outlook for administrative computing has improved, that arrangement caused serious problems and left a bad taste in many administrators' mouths. Sim-

mons discovered that while it did not have the needed expertise on campus, the management team it hired did an unsatisfactory job. Because the college acquired a system larger than it needed, a joint operation evolved. Top administrators plan on moving academic use to the PDP 11/34 when demand on the HP3000 is too great. Faculty, however, think that the PDP 11/34 is dedicated to the Applied Computer Science program.

The third decision was to develop the Applied Computer Science program and purchase the PDP 11/34 in support of this new endeavor. There were a variety of reasons for development of the new program. But when faculty developed it, they designed a program which matches the saga that guides the institution. Applied Computer Science combines professional skills with the liberal arts.

Simmons still depends on Soltzberg's expertise and interest. He is now involved in all aspects of computing on the campus. Soltzberg advises both administrative and academic users, develops budgets, oversees the faculty committee, and is involved in the day-to-day problems of operating the HP3000 and providing access to academic computing through the networks. Users feel that under Soltzberg's guidance the school's needs are being met in an effective manner. The institution realizes and appreciates Soltz-

berg's dedication to computing at Simmons. This is reminiscent of the college's attitude towards others who have provided leadership in the past.

Chapter 6

Regis College

> Throughout its history of steady growth, Regis, as a strong Catholic college for women, has consistently called upon each student to develop her potential to become a positive influence on society.
>
> -- Regis College Bulletin

Regis College is a traditional Catholic liberal arts college for women.(1) Founded in 1927 by the Sisters of Saint Joseph, it remains dedicated to the goals of educating women intellectually, morally, and spiritually. Sister Dineen, long time dean of the college, transformed Regis from a convent school into a "real post-secondary institution" in the early 1960s. Aware of the expectations of today's students, the college now complements the traditional liberal arts with career programs and internships. The college's mission is important to those involved with the institution. They have a clear picture of the college's purpose. But Regis's saga does not set it apart from similar Catholic institutions.

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(1) The story of computing is simpler at Regis than at the other sites, thus the case in shorter and contains less detail. I included it as an example of a college that has not developed computer resources to a large degree.

The college appeals to a definite segment of the college-bound population: women interested in a Catholic education. The school's relatively protected environment is also an attractive feature to its eleven hundred undergraduates. At Regis they can learn confidence and independence. In the class of 1985, 73 percent came from Massachusetts and 10 percent came from the other New England states. Many students are the daughters of alumnae and graduates maintain close ties to the institution.

The faculty at Regis value teaching and concern for the individual student. Half of the 55 full-time and 28 part-time faculty members are Sisters of Saint Joseph. The faculty are aware of the current climate in higher education. They are willing to change and introduce new programs, as evidenced by increased emphasis on career programs in recent years.

Reliance on Networking

Regis College has not developed extensive computing facilities. It relies on networking for the vast majority of its academic computing needs. The college joined ACCOMP in 1970. A leased line was a relatively inexpensive and simple means of providing computer resources for faculty and

students. In 1977-78 Regis leased a second port from ACCOMP and added a third in the fall of 1981. Computing costs are carried as a separate line-item in the college budget. The terminals are in the main college building, next to the office of the one faculty member who teaches computing. Regis has no computer staff other than this faculty member.

The college also lacks administrators who are knowledgeable about computing. Edward Mulholland, the dean of the college, is responsible for computing. He feels somewhat insecure in the role and relies on the programming instructor's knowledge and informal contact with faculty and students who use the school's computer resources. He also seeks advice from colleagues at small colleges which have similar computing needs.

No one at Regis has taken an active role to encourage the use of computing on the campus. Several years ago a member of the English Department did become excited about the possibilities of computing and became actively involved. She soon found, however, that she could double her salary in the business world. Needless to say, she did not stay at Regis long. The school now provides some funds for a few interested faculty members to attend computer conferences in the local area. Mulholland knows that the school should do more with computing and feels responsible for motivating the

faculty. He does not have the knowledge or expertise to do so, however.

Computer-related courses at Regis are limited to a few departments. Students can take several introductory programming courses. The Mathematics Department uses computer resources for programming and statistics classes. The sciences and social sciences have used a few applications such as statistical packages for data analysis. Students with questions or problems related to class computer assignments must seek assistance from their professor or other students.

While students have always had free access to the college's terminals, there are three user priority classes. Currently, students in the programming courses are highest on the "pecking order" for terminals. Next are students in other courses using computing. Faculty are lowest on the list. As demand has increased this sometimes caused severe competition. Some faculty complain to Mulholland that because access can be difficult and unpredictable they give fewer computer assignments. Mulholland is considering signup sheets in response to faculty complaints. He recognizes that this simple form of control could alleviate much of the difficulty. Yet he is hesitant about taking this step.

A Reassessment of Computing Needs

Regis has minimal administrative computing. The business office uses an outside service bureau for its needs. The registrar's office has a contract with the Worcester Area College Computer Center for batch processing of student records (WACCC is described in Chapter Three). Admissions and development share a small word processor. Administrators at Regis realize, however, that the college could make beneficial changes in using computer resources.

In the summer of 1981 the president formed a committee to study computing. The committee, which consists of administrators and faculty with an interest in computing, asked each office to write a statement of computing needs. These became "wish lists." The committee also considered possible methods of providing computer resources. It reached one major decision: administrative and academic computing will remain separate if the school purchases a small system. Arguments about possible security problems for administrative data convinced the president of the benefits of separate systems. The committee has now asked consultants from NERComP, a regional computing association, to study the college's needs and make suggstions about possible directions for administrative computing.

Future Development of Academic Computing

Once the computer committee decided against a joint system, Mulholland recognized that academic computing was his problem again. He now realizes the value of computer literacy and wants the faculty to consider the issue. Programming courses have become much more popular in recent years. The introductory programming course enrolled 33 in 1978-79, 77 in 1979-80, 106 in 1980-81, and 71 in the fall of 1981. But it has not been possible for interested students to tie computing classes together.

Thus Mulholland asked the programming instructor to design a new sequence of computer-related courses. The sequence will consist of five or six courses. Students will be able to tailor the courses to meet their specific interests. Students who complete the entire sequence will receive a certificate, but Mulholland thinks that only a small number of students will take this option.

Eventually Mulholland may propose a Computer Science Department. Academic computing has always been a separate budget item and the courses are now listed separately in the catalog. Although they are part of Mathematics, that department's members have always resisted computer science courses. Mulholland knows the small college does not need another department, but the structure for the department already exists.

Because administrative and academic computing will remain separate, Mulholland is also begining to consider alternative facilities for expansion of academic computing. He wants to add another ACCOMP port and terminal next year. Regis purchased two microcomputers (TRS-80s) for the Mathematics Department in 1979. Although their service record has been disappointing, Mulholland is considering additional microcomputers as a means of supplementing the ACCOMP ports. He wants to use them for the expanded computer sequence and to encourage other departments' involvement with computing.

Summary

Regis has had a minimal level of computing for the past decade. The institution has neither the structure nor the culture to support extensive computing efforts. The institution has no knowledgeable staff regarding computers. The lack of personnel has meant that there have been no local experts to push for computer resources or to support the efforts of others. Regis must rely on outside consultants, such as those from NERComP, to provide the direction for computing.

ACCOMP has provided adequate computer resource. It has allowed the school to pursue some computing without acquir-

ing equipment or costly personnel. Through ACCOMP the college has obtained enough computing to meet its basic requirements. But competition for terminals has constrained interest among faculty and students.

Mulholland wants to encourage computing, but he is uncertain of the route to take. The new certificate program demonstrates the expanding career orientation of programs at the college and the faculty's acceptance of changes in the college's curriculum. But if academic computing is to expand into other disciplines, Mulholland knows he must reevaluate the college's approach to computing, provide additional support, and encourage use among faculty and students.

Chapter 7

Wellesley College

> A college like Wellesley has a proper function, even if not, strictly, a proper end. Its function is to be a living argument for the proposition that the habit of learning and reflection is not only enormously useful but intrinsically satisfying.
>
> -- Wellesley College
> Self Study, 1979

When Henry Fowle Durant founded Wellesley College in 1870, he viewed his actions as revolutionary. He foresaw great struggles and "vast reforms in social life." He wanted to educate women for this revolution. Durant stated "women can do the work. I give them the chance." Wellesley's maintenance of Durant's high standards provides the foundation for its saga. In 1971 the college's Commission on the Future stated that among the important characteristics of the college were the high quality of faculty, students and administrators, the concentration on undergraduate education with concern for individual students, a commitment to the education of women, and an underlying belief in service to society. Wellesley's motto, "Non ministrari, sed ministrare" or "not to be ministered unto, but to minister

to," reflects the commitment of service to others and remains part of each student's experience of the college.

Wellesley offers students a "traditional liberal arts" education where learning for learning's sake is important. A Wellesley education upholds traditional values, but the college is proud that its curriculum is not typical or run-of-the-mill. Students may design their own major, for example, and extradepartmental courses cover a wide range of topics. Wellesley's cross-registration program with the Massachusetts Institute of Technology provides access to many science and engineering courses usually not available at a liberal arts college. The college's small size enables close working relationships between faculty and students, but its offerings mirror those of a much larger university.

Wellesley attracts a diverse and talented student body of approximately two thousand undergraduates. Faculty describe them as serious and achievement oriented. Anne Morgan, the director of the alumnae office, thinks that while some may "chafe" in the college's environment, most genuinely appreciate their education after graduation. Alumnae retain strong bonds to the institution. The reasons for this attachment are difficult to articulate, but alumnae actively participate in ongoing activities and fund raising. Morgan thinks they respond to something special in their

experience at Wellesley and want to give to the institution in return.

Wellesley attracts faculty who are scholars in their respective fields and care about teaching. The 222 full-time and 75 part-time faculty members involve students in their research and develop close ties to students through activities such as the dorm associate program. Faculty have high expections of students and are academically demanding because they know the students are capable of doing well. Faculty also serve on many committees and share in the administration of the college. The committees are a necessary part of the college's administrative structure. While they may slow the decision making process, they provide wide support for decisions and goals.

Wellesley has a tradition of strong presidents. (All of the college's presidents have been women, demonstrating its commitment to women's education.) In 1914, for example, Ellen Fitz Pendleton reopened Wellesley only four days after a fire destroyed the college building. But administrators and faculty have a difficult time picking specific individuals who were important to the college. Each president gave of herself to the school but took a role secondary to the institution. Similarly, faculty members are not remembered for their individual efforts. Rather they are cited for upholding the values and traditions of the institution.

The Pursuit of Computer Literacy

Instructional computing at Wellesley began in a modest form in the 1969-70 academic year. The college's first computer resources were punched cards and batch facilities at the Massachusetts Institute of Technology. It then leased terminals and accessed the Dartmouth Time-Sharing System (DTSS) via NERComP. Wellesley also rented a Digital Equipment Corporation PDP 8 for a year. One person was in charge of the computing resources and taught two computer- related courses. The number of users doubled every year, reaching 600 students in 1975.

In the early 1970s Wellesley undertook a reevaluation of its science program. One result was the construction of a new Science Center to house the college's science departments. Nancy Kolodny, an assistant professor of chemistry, was director of the Science Center in 1975, although construction was not yet complete. Kolodny had some interest in computing, but primarily because of her role as director of the Science Center, Wellesley's President, Barbara Newell, gave her responsibility for computer science. The president's advocacy of computer literacy was an important factor in stimulating the college's interest in computing. Kolodny formed a faculty committee to investigate the situation. The twelve members of the committee were all junior

faculty who shared an interest in computing. The committee actively tried to improve computing at Wellesley. President Newell relied on the faculty to implement a computer literacy program. When the individual who had been in charge of computing retired, the committee hired Gene Ott as director of computer ccience. Ott still works closely with faculty and reports directly to the dean of the college.

Although President Newell expressed interest in computing, she did not provide any financial resources for computer literacy. Thus in 1975 Kolodny and Ott were excited to learn of the National Science Foundation's grant program for Comprehensive Assistance to Undergraduate Science Education (CAUSE). NSF actively marketed the grants, and requested proposals from colleges and universities that wanted to expand computer resources. Kolodny, Ott, and another faculty member wrote a proposal for developing computer literacy at Wellesley. They requested a major equipment purchase, but they also carefully described their goal of computer literacy and methods of evaluating students' progress towards this goal. The Wellesley CAUSE proposal was an early articulation of computer literacy.

NSF only funded sixty of the more than 700 proposals for CAUSE grants submitted in the first year. One of these was Wellesley's. With the grant of about two hundred and fifty

thousand dollars, the college purchased a DEC-2040 which it installed in the Science Center in 1976. It built one terminal room in the Science Center and another in the library.

Ott is a computer center director. He manages the system which is known as DECstar, short for DEC-system 20 for teaching and research. Ott and Kolodny felt strongly that a centralized facility was necessary for the success of their computer literacy program. Strong central support meant that users would only have to learn one system. Every student receives a directory on DECstar by registering at the college. The allocation policy is free access. Students have a limited amount of disk space, but can obtain more if they justify their need. Students may reserve terminals for two hour slots.

At the same time that Ott and Kolodny applied for the CAUSE grant, they also sought funds from the Alfred P. Sloan Foundation. Wellesley's development office told Kolodny that the Sloan Foundation wanted to give Wellesley a grant. Ott and Kolodny knew that even if computing facilities were available, they would not be used, nor would computer literacy become a reality, unless the faculty integrated computing into Wellesley's curriculum. Thus they wrote a proposal for a "Faculty Participation Program" which outlined a three prong approach to faculty education. First, Ott and Kolodny

proposed a series of intensive faculty workshops to be held over three summers. Second, they wanted to hire a "courseware specialist" who would provide continued technical support for faculty. Third, they suggested that the dean of the college grant units of release time to faculty members who wanted to pursue computer-related topics. The process of grant approval was slow, but in February 1978 the Sloan Foundation awarded Wellesley a grant comparable to the CAUSE award.

Ott and Kolodny held the first Sloan workshop in June 1978. The dean of the college invited all faculty members in the Social Science Division to apply. Ott and Kolodny selected twelve of the fourteen applicants. They gave special attention to tenured faculty members because these individuals could provide the greatest support for computer literacy at Wellesley. Participants in the workshop received a stipend of one month's salary. The first two weeks of the workshop consisted of lectures and instruction. In the second two weeks faculty had to produce a "courseware specification" that outlined how they planned to use computing in a course. In many cases this required writing or modifying software to meet their needs. During this phase participants received a great deal of individual attention. In June 1979 and June 1980 Wellesley held similar workshops for faculty in the Natural Sciences and Humanities.

When writing the two grants, Ott and Kolodny knew that support for computer resources was crucial. Thus they planned several forms of support in addition to the faculty workshops. One was to ensure that DECstar was as "polite and friendly" as possible. They wanted a system that was nonthreatening. DECstar's technology remains in the background, and how it can be used receives greater emphasis. Use of disks is encouraged over use of tapes, for example, because disks require less technical knowledge.

Another means of support is the availability of personnel. Ott realizes the need for a competent user-oriented staff. He tries to insulate them from organizational issues and help administrators realize the value of good computer staff. In addition to Ott, there is a systems analyst who is responsible for maintaining DECstar, a courseware specialist, and an user service coordinator.

The Sloan grant originally funded the courseware specialist position. Wellesley now pays fifty percent of her salary. (1981 was the first year of any Wellesley funding for the position and the last year of any Sloan funding.) The nature of the job has changed over time. Originally the position's duties included designing and running the Sloan workshops. Eleanor Lonske, the current courseware specialist, is now the primary contact for faculty members who have

requests of the computer science staff. Lonske is involved, for example, in developing a graphics editor and Chinese characters. She also identifies and brings to Wellesley needed application packages. Because of the small size of the staff, Lonske also describes herself as a "utility ball player" who can provide whatever support is needed.

The user services coordinator, Hsiao-ti Falcone, is readily available to help solve users' problems. She also provides documentation and maintains terminals. One of Falcone's duties is managing the twenty-nine student consultants who are the primary contact for students with questions or problems. A consultant is on duty in each of the two terminal rooms from 8:30 a.m. to 10:00 p.m. virtually every day. The financial aid office selects work-study students for the positions. Twenty of them were new this year and many had little or no previous experience with computing. Falcone trains the consultants. She expects a lot from them and usually is satisfied with their performance. Falcone reports that most consultants enjoy their work and their morale is high. In addition to being available to students, each consultant has special duties. These might be as simple as cleaning and checking terminals or as complicated as running the nightly system backup.

The faculty computer committee was another early means of support for computing at Wellesley. The committee members actively pursued development of computer resources with the support of the college's president. After Ott's arrival, however, the committee became less important. In 1976 it became ad hoc and advisory. Currently Ott meets with the committee at the end of each semester. Together they review common problems and complaints. Ott finds it helpful to do this in the group setting because users learn of each other's problems and of the competing demands placed on the system and staff. The group also sets priorities for future additions and developments. Among the original committee members, four are still at Wellesley and now have tenure. Ott knows that he can draw upon the committee for support if it becomes necessary.

Evaluation of the computer literacy goal has always been a central part of computing at Wellesley. Ott and Kolodny defined five levels of computer literacy in the NSF grant proposal:

Level 0 - no use of computing
Level 1 - signing on and using an interactive program
Level 2A - programming ability in at least one language, and having written a program to solve a problem
Level 2B - using a sophisticated software package (like SPSS or STATPACK)
Level 3 - programming well and having written a program to be used by others.

Because all students are assigned directories, DECstar keeps track of Level 1 competency automatically. To determine the higher levels, the computer science staff compares terminal signup sheets and class lists for courses that require computing skills. Although a specific computer literacy goal is not an official requirement at Wellesley, faculty and administrators acknowledge that students should be computer literate. In the class of 1981, 87 percent of the students had achieved at least a Level 1 competency.

The staff also surveys attitudes towards computing on the campus each year. The surveys demonstrate the success of the computer literacy program. When asked if computers are relevant tools in their discipline, 51.9 percent agreed in 1974 and 82.9 percent agreed in 1979. Those agreeing with the statement that computers are relevant teaching tools rose from 45.3 percent to 53.3 percent over the same period. In June 1976 only 33 percent of the faculty met or exceeded the level 1 literacy requirements. This increased to 58.1 percent in April 1979.

Virtually all faculty participants in the Sloan workshops have integrated computing into their classes. This includes laboratory simulations and quizzes in the sciences, data analysis in the social sciences, and language drills and games in the humanities. Students and faculty also use

a sophisticated editor, EMACS, to enter and edit text. Students in one religion course, for example, use EMACS for their papers. This is particularly helpful for cross-registered MIT students who can use DECstar's telecommunication facilities to obtain copies of papers that other students will present in class. Faculty also use DECstar for their own research and writing. Thus computer resources now supplement other classroom activities at Wellesley. Users view the computer as a tool that has many applications in the liberal arts environment.

The use of computing at Wellesley has grown tremendously

Year	Connect Hours	Student Users
1975-76	5,200	650
1976-77	5,800	800
1977-78	9,600	818
1978-79	17,300	1,126
1979-80	33,000	1,318

Wellesley College Connect Hours and Student Users

Table 7.1

(see Table 7.1). Twenty-three of the college's twenty-eight departments now use computing. Demand increased, however, at a rate that outstripped supply. This became critical in the 1980-1981 academic year when, by most accounts, the computing resource became very scarce. Faculty thought twice about giving computer assignments because they knew that

students would have trouble gaining access to DECstar. Several institutions that had leased ports from Wellesley became dissatisfied and terminated the arrangement, leaving Wellesley without valuable income. Ott had anticipated the increased demand, but he was unable to convince administrators of the need for more computer resources or that problems would arise if the college did not obtain them.

Consideration of Administrative Needs

During the 1979-80 academic year, administrators began to reconsider their computing needs. Several years earlier the college had contracted with an outside service bureau to develop administrative computing. Once the system was complete, administrators thought they would bring it back on campus. The college, however, was not entirely satisfied with the situation.

Wellesley asked a panel of NERComP consultants to study administrative computing and make recommendations. The consultants cited several major problems in the report they presented in April 1980. While fairly responsive for a batch system, new developments were extremely slow. Furthermore, the batch programs could not be converted to interactive programs. The consultants also uncovered wasted

and redundant efforts. They traced this to a lack of clear guidelines and central organization on the campus.

The consultants' first recommendation was the creation of the position of manager of administrative data processing, which would report to the vice-president of business and financial affairs. They felt that the college should discontinue any further development efforts until it filled this position and the individual could take an active role in further decision making. Second, they recommended formation of a computer resource steering committee that would oversee both administrative and academic computing. They suggested that membership include a systems programmer, faculty, administrators, and two students. Third, they advised development of an in-house Data Base Management system. Finally, they recommended comparing the costs of upgrading the DEC-2040 to a 2060 for joint operation and purchasing a separate DEC-2020 for administrative computing. The consultants favored the joint approach. For these reasons they suggested that administrative users gain access to DECstar so that they could begin to become familiar with interactive computing.

The academic user community was aware of the consultants' report and recommendations. Some faculty were concerned that with a joint operation they might get "saddled"

with incompetent administrative staff or face stiff competition for resources. But their primary interest remained finding additional resources for their own computing needs.

Wellesley followed the consultants' first piece of advice and hired Anne Blackwood in Jaunary 1981 to manage administrative data processing. She worked with a committee to review the other suggestions and the possibility of joint operation. There were several concerns about a shared system. One was the overload already present in academic computing. Another was the availability of Data Base Management software that would run on DECstar. Blackwood could not find a suitable integrated data base and query language that met the college's needs. A final concern was security. This was of special interest because cross-registered MIT students use DECstar, and MIT students have a reputation for breaking the security of any operating system. Thus the committee recommended separate administrative and academic systems, a decision that required the approval of the college's board of trustees.

Blackwood's next began looking for hardware and software for administrative computing. She located a vendor, AXXESS, that sold both. In July 1981 Wellesley installed a Prime I5000 which Blackwood feels is powerful and easy to use, and which permits many offices to share information. It came

with demonstration and test modules so users could familiarize themselves with the system before their offices went on-line. Rather than risk possible problems in electronic transfer of data from the service bureau, Blackwood's staff reentered all data by hand. The first office went on-line in September 1981. Although she feels that there are lots of loose ends to tie together, Blackwood has kept to the planned implementation schedule.

The move to separate systems was a major undertaking for Wellesley. The initial cost of the administrative system was more than what the college spent on academic computing over a six year period. In addition to Blackwood, staff members include an applications programmer, a systems administrator, an analyst, and a temporary implementation specialist. Once the system is fully developed, a chargeback system will be used to recover costs from users. Blackwood feels that she has administrative support for her efforts.

Continued Growth of Academic Computing

Deliberations on administrative computing delayed action on the question of upgrading DECstar. The uncertainty caused by the search for Wellesley's new president and the continued opposition of some faculty and administrators to

computing further complicated the situation. Ott and other users still faced those who believed that computing is a technical or vocational skill which has no place in a liberal arts college. In many cases opposition may have been founded on ignorance and in some cases faculty members may have been concerned about losing students to new computer-related courses. Because of this opposition, Ott, Kolodny, and others had to fight long and hard for the funds to upgrade the system. Eventually they won the battle, and over the summer of 1981 Wellesley upgraded DECstar to a DEC-2060 capable of handling sixty jobs at one time. Users are now pleased with the system. Ott is still trying to make more terminals available, but he feels that DECstar should be able to handle demand for three to four years.

Students are involved and using computers at Wellesley. The availability of technical and psychological assistance eases the problems associated with using the resource. Some students quickly familiarize themselves with the system, some must work hard to overcome their fears, and others remain more timid -- once they learn one way of doing something they are hesitant to try new methods. Kolodny feels that getting a student to use DECstar is not always enough to convince her that she really knows how to use it. Despite interest in computing, there are few "computer

hacks" at Wellesley. The students enjoy and use the computer but they do not tend to become heavy users just for the sake of using DECstar. They view the resource as a tool for course assignments or word processing.

A recent competition, however, demonstrates the students' excitement about computing. The student consultants had a contest to design a T-shirt that they would wear while on duty. To the surprise and delight of the computer science staff, the winning design is so popular that many students want to purchase one. The staff is pleased with the response, but they want to retain some degree of exclusiveness to differentiate consultants from other users. They view the T-shirt's popularity as a demonstration of support for computing among the students.

Wellesley's faculty have received a great deal of support and encouragement for developing computer applications. Primary sources have been the Sloan workshops and the courseware specialist. Faculty who were involved in a workshop have excited their colleagues about computing. Mini-workshops are now available during January for faculty and students who want additional instruction in using popular packages.

The attitude of the computer science staff is also important. Their approach is to provide what users need, if

at all possible. Ott, for example, obtained the necessary chip to make overstrike accents available for the Chinese Department. (The accents indicate one of the four possible tones given to Chinese vowels.) Faculty have no major wishes for services or facilities that are not currently available. But their expectations are high because they have had such good resources available to them and a generous allocation policy. Ott realizes, however, that to maintain the progress to date he "must continue to be evangelical." He knows that without continued efforts computer use would decrease.

Wellesley's major concern has been integrating computing into its liberal arts curriculum. There have been a few computer science courses but there is no formal computer science major. Before introducing a major, Ott wanted faculty to understand that computing is appropriate in many disciplines. Last year the dean formed a committee to discuss a computer science major. It recommended that the major be approved several years from now.

Ott and others think the college will establish the major much sooner. Wellesley already offers five computer courses on an extradepartmental basis and these are among the largest classes at the college. Students may declare an independent major in computer science. Ott wants to develop

a formal major carefully, however, to avoid ending up with a "hodgepodge." He first wants to build an administrative structure to convert computer science into an academic department. Some faculty opposition remains. Any hint of vocationalism or technical courses in computer science increases the opposition of some faculty and administrators. And it has traditionally been difficult to create new departments at Wellesley. It is clear, however, that a computer science major will be a reality shortly.

Summary

Ott and Kolodny have identified four factors crucial to their success in introducing computing at Wellesley. First was President Newell's articulation of the value of computer literacy. A small but active group of faculty and students pursued this goal. Second was identification of specific individuals as the project directors to be responsible for development of computer literacy with the advice of the academic computer committee. Third was the careful formulation and documentation of the project goals and plans to achieve them, including a thorough cost analysis. Finally, and most crucial was

> a commitment to provide adequate, reliable computing resources that would remain stable over a period of at least

> five years to make the computing resource available to users on a free access basis.

Wellesley's top administrators have supported computing at the school. They have relied of the expertise of Ott, Kolodny, and other interested faculty. They also realized the value of computing to Wellesley. President Keohane endorsed its importance last September in her inaugural address. She stated that first among three basic tasks of the college was ensuring

> that our students have grasped the rudiments of several essential technological skills, such as computing, and are familiar with the basic methods and processes by which scientists reach their bold conclusions, even though not all students become specialists in science or technology. In this way we make it more likely that educated persons in the future will be informed users of the powerful tools at their disposal, capable of appreciating and taking advantage of their powers.

In reaching its current level of sophistication, Wellesley was fortunate to obtain generous outside funding, both for computer facilities and faculty education. The college also had dedicated and knowledgeable individuals willing to persevere for what they wanted. While the work of these individuals is widely acknowledged, they have remained in the background. As is true of Wellesley's past leaders, Ott and Kolodny are not widely known on the campus as the ones

responsible for the success of computer literacy. Wellesley values service to others, which Ott and Kolodny have provided. The personnel structure also reflects the value Wellesley places on service. Staff actively provide support for users and do all they can to encourage use. The staff are people-oriented rather than machine-oriented.

The pursuit of excellence is another part of the success of computer literacy. The value placed on excellence is evident in Wellesley's computer literacy programs. Generous facilities and capabilities are expected and provided.

Finally, integration of computing into the curriculum was a careful, slow, and steady process. Well laid plans have nurtured the campus' understanding of how computing fits the college's traditional mission. Ott emphasizes that computing is information processing not just "number crunching." He has taught faculty and students that computing is a tool which supports their work. Only after the resource gained widespread acceptance was the possibility of a computer science major introduced. Even this next step stresses the nontechnical, logical, and analytic apects of computing. When a major is formalized, it will reflect Wellesley's saga.

Chapter 8

Discussion

Each of the five case studies demonstrates the influence of organizational characteristics on computer use. Before discussing the effects of structure and culture, however, it is helpful to briefly caricature each case (see Tables 8.1 to 8.4). Worcester Polytechnic Institute uses computing in a technical environment. It is a natural part of the institution. WPI's computer center, WACCC, provides academic and administrative services. Its staff is technically oriented.

Babson students must take introductory computing as part of their management education. In the past, faculty have voiced stronger support for computing efforts than have administrators and financial considerations have greatly influenced the decision-making process. The computer staff has been machine-oriented and reactive to users needs. Under faculty pressure, however, the staff is becoming more proactive and user-oriented.

Simmons College is satisfied with "supermarket" computing. It uses networking to access a number of computer facilities. When it installed an administrative computer system, academic users took advantage of the surplus

	WPI	Babson College	Simmons College	Regis College	Wellesley College
Position	Computer Center Director	Computer Center Director	Computer Center Director	--	Computer Center Director
Reports to	President	Financial Vice-President	President	Dean of the College	Dean of the College
Professional Staff (Academic)	5.5	5	1	0	4
Student Staff	2	12	8	0	29
Role	Machine-oriented Proactive	Machine-oriented Reactive	User-oriented Reactive	--	User-oriented Proactive
Top Management Knowledge	Yes	No	No	No	No
Top Management Support	Active	Inactive	Inactive	Inactive	Active
Committee	Policy	User	Policy & User	--	User

Characteristics of Personnel

Table 8.1

	WPI	Babson College	Simmons College	Regis College	Wellesley College
Computer(s)	UNIVAC 90/60 DEC-2060 DG NV/8000	PDP 11/70 VAX 11/780	HP3000 Series III ACCCMP (networking) NERCcmP (networking)	ACCCMP (networking)	DEC-2060 Prime I5000 (Administrative)
Microcomputers	Many	Limited	Apples Also in Laboratories	TRS80s	Apples Also in Laboratories
Academic and Administrative	Joint	Joint Facility (Separate Machines)	Joint	Separate	Separate

Characteristics of Facilities

Table 8.2

	WPI	Babson College	Simmons College	Regis College	Wellesley College
Policy	Free Access	Free Access	Free Access	Free Access	Free Access
Signup Sheets	No	No	1 Hour	No	2 Hours

Characteristics of Allocation

Table 8.3

	WPI	Babson College	Simmons College	Regis College	Wellesley College
Computer Literacy Goal	Implicit	Explicit	Not Important	Not Important	Explicit
Required Course	Yes	Yes	No	No	No
Major	Computer Science	No	Applied Computer Science	Proposed Certificate	Proposed Major
Word Processing	Yes	Yes	No	No	Yes

Characteristics of Use

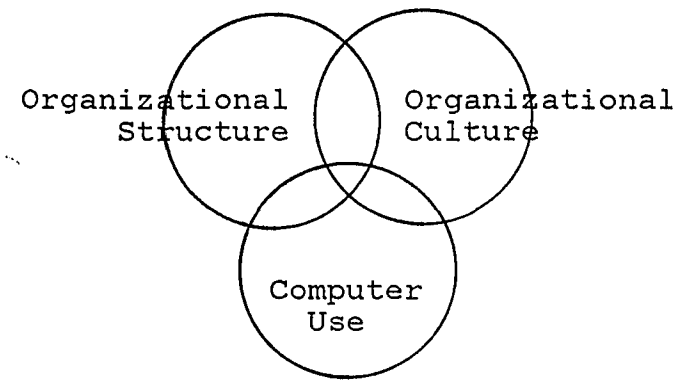
Table 8.4

resources. One individual and an ad hoc faculty committee support academic computing. A new Applied Computer Science program combines practical computing skills with the liberal arts in the Simmons tradition.

Regis College has limited computer use. It relies on networking to provide the resource. The dean of the college is not comfortable with his computer-related responsibilities. The college has recently designed a sequence of courses for its students who want a certificate in computing.

Wellesley College has a carefully planned and implemented computer literacy program. Two grants provided funding for equipment and faculty education. The computer staff is user-oriented. A new computer science major is likely within the next year. Proponents of computing have made a concerted and largely successful effort to overcome opposition to computing in the college's liberal arts environment.

The five cases illustrate the relationships between organizational structure, organizational culture, and computer use. Figure 8.1 depicts these relationships. The discussion that follows demonstrates how both structure and culture influence computing. It notes that structure affects use as the literature predicts. It then goes beyond structure and evaluates the relationships between organiza-



Intersecting Organizational Spheres

Figure 8.1

tional culture and use. The chapter briefly mentions the reciprocal influences of use on the organizational factors and the interaction between structure and culture. It also relates the findings to the stage theories of computer use mentioned in Chapter Two. The Chapter concludes with several suggestions for administrators at other institutions.

The Need for Structure

With the exception of microcomputers, some kind of organizational structure is necessary to support computer use. The structure can be fairly simple. A part-time coordinator suited Simmons' early needs. Without structural support computing is apt to flounder. There are a number of reasons why Regis does not have better developed computer

resources, and a lack of structure is among them. As the literature suggests, personnel, facilities, and allocation policy all affect computer use.

Personnel. Several points emerge from consideration of personnel issues. The availability of at least one individual who is familiar with computing is essential to computing efforts. Sophisticated knowledge is not necessary, but use and development of computer resources are difficult without some technical expertise. The institution must be able to articulate its computing needs and know how to meet them. A knowledgeable individual can guide the decision-making process. Regis illustrates the difficulties of proceeding without someone in this role.

The location of computer personnel within the organizational structure is also important. Babson demonstrates this point. Some of its faculty are dismayed at Putney's lack of concern for educational outcomes and his reliance on financial considerations. The faculty committee at Babson must fight the personnel structure in order to accomplish its goals. Its efforts focus on structural problems and changes instead of development of academic computing. The Babson case also illustrates the reciprocal influence of computer use on structure. Faculty members' frustrations with computing motivated them to lobby for changes in the organizational structure.

The roles of personnel are as important as hierarchical position. Staff may support users or computer facilities. Jackson's staff at WPI is machine-oriented. Staff members focus on the facilities rather than user services and support. Ott at Wellesley, on the other hand, does all he can to support users. The degree of support his staff provides affects the students' experiences with computing. The staff eases the difficulties inherent in learning to use a computer. Support can help students overcome fear and hesitation. Personnel may also be proactive or reactive. Some Babson faculty do not feel that the computer center staff has been responsive to their needs. The staff has been reactive. Penetration of computing at Babson has declined, in part, because of the staff's orientation. Wellesley's staff has taken the initiative in providing services.

The value of good relationships between computer staff and the institution's top management is frequently mentioned in the literature on managing computer resouces. High-level administrators trust and rely on their computing staff at each research site. This is a necessity because the administrators are not knowledgeable about computing. President Holmes at Simmons feels that he is better off leaving computing to his director of computing in the same way that he leaves purchasing or accounts receivable to the business

office. He does not view his ignorance as a problem. Other administrators, however, are trying to learn more about computing so they can better understand the decisions they must make.

Top management's support of computing also affects use. The lack of interest of the former academic vice-president at Babson was partly responsible for the current personnel structure and the resultant problems. At Simmons, Holmes' inactive support has not encouraged faster growth of computing. With the strong backing of top management, as at Wellesley, computing has a better chance of flourishing.

Facilities. After initial efforts each college chose either networking, central facilities, or a combination of these two. It now appears all except Babson will have decentralized resources in the near future. Decentralization will likely mean that users will have greater variety and availability of resources. Preferences for separate academic and administrative systems, the introduction of machines dedicated to special tasks, and the increasing use of microcomputers all contribute to the shift towards decentralized facilities.

As the literature suggests, concern about shared versus separate academic and administrative facilities is common. Wellesley and Regis have decided to separate the two tasks.

Administrators at both schools worried about the security of administrative data. Since Babson operates two machines in one facility, problems do not arise. Simmons proclaims opposition to joint operations, but actually shares facilities and personnel between the two tasks. WPI also operates a joint system. With the exception of Simmons, which will probably encounter problems when slack resources become scarce, the colleges have resolved the issue of shared academic and administrative facilities. As decentralization continues, the question of joint versus shared operations will likely become less important. Many schools will follow Wellesley and Regis' example and choose separate systems for reasons based on educational philosophy and security rather than cost or capabilities.

The presence of word processing at Babson, Wellesley, and WPI illustrates the effects of providing facilities to meet specific needs. Students at these schools increasingly use editors and printers. Word processing may or may not interfere with other uses, but Wellesley, for example, clearly feels that it is a valid function. There are different rationales for providing word processing capabilities. But whatever the reason, such facilities increase computer use because they serve a real need. In some cases word processing is seductive. Through its use students and

faculty members learn about and become familiar with computing. Then they may use the computer for other tasks and increase their demand for generous computer policies.

The availability of microcomputers is another example of the effects of special facilities. Several of the colleges use small dedicated systems in laboratory and experimental settings. Simmons' "Apple Cart" makes a microcomputer readily available for classroom use. It has prompted some faculty to write special software and teach in new ways. The Chemistry Department at Wellesley has designed microcomputer programs for laboratory quizzes and demonstrations. Microcomputers have a tremendous impact if they are available. The decision to purchase them affects academic computer use. Yet each institution has introduced microcomputers with little thought given to evaluating their effects or coordinating their use.

The use of microcomputers and the shift towards decentralization may influence the management of computer operations. This is another example of the reciprocal relationship between use and structure. When an individual or department can purchase a powerful microcomputer, the need for formal structure decreases. Decentralization could place greater value on the position of a computer czar if an institution wanted to maintain control over proliferation.

But Jackson, for example, does not want responsibility for the proliferation of WPI's decentralized facilities. Of course a coordinated effort to use microcomputers for an entire campus would still require structural support, as will the maintenance of centralized facilities for those tasks that require the capabilities large computers provide.

As computers continue to become better understood and easier to buy, institutions may treat them like laboratory equipment or educational supplies which are not purchased centrally. Colleges are likely to follow WPI's example and relax control over decentralized computer resources. This phenomenon would follow the treatment of other educational resources. A library, for example, is responsible for the majority of centralized printed resources on a campus. But individuals can still purchase their own books and journals. The institution does not try to control activity at the individual level.

Allocation. With minor exceptions each college follows a free access philosophy. The colleges budget academic computer costs as overhead and do not charge faculty or students for computer use. The rationale for the allocation policy arises from educational goals rather than interest in managerial control or cost recovery. Administrators feel that computing should be readily available to students just

like library services. Restrictions remind users of the value of disk storage and control demand for an expensive resource. Several of the schools use signup sheets to spread demand and to give students the opportunity to plan their work. Signup sheets and restraints alleviate allocation problems to some degree but, they do not solve the basic problem of scarce resources.

Consistent with the free access philosophy, the schools allow demand to be user driven. This is a common philosophy (Ohio Board of Regents, 1973). When Wellesley faced a severe shortage of computer resources, for example, the staff did not evaluate or restrict use. Ott felt that he should not decide which uses are the most valuable and should have priority. This approach is not effective, however, if users are not aware of the problems involved. Instead of using the system more effectively, they may simply overload it until no one is satisfied. If the system can be upgraded, as it was at Wellesley, such a policy may be useful. But in the long run, demand may increase to the point where the institution can no longer adequately provide the resource.

The free access philosophy precludes a means of managerial control. It restrains the manager's ability to spread demand and ensure efficient use of the resource. A "funny

money" chargeback scheme might provide control. But each institution is interested in providing as much computing as students need with the fewest number of restrictions. Wellesley feels, for example, that a chargeback system would be counterproductive to its computer literacy goal. Curiously, no institution has evaluated the free access philosophy to determine how it really affects use. All operate on assumptions about user behavior. Thus the colleges forfeit one means of managerial control without certain knowledge of its effects. Under conditions of scarce resources some kind of chargeback system might prove effective.

The cases all demonstrate the effects of personnel, facilities, and allocation on computer use. As the literature suggests organizational structure accounts for many of the differences among the colleges. But it does not account for all of them. Organizational culture further explains computer use at the institutions.

Beyond Structure

Every institution has its own unique organizational culture. As discussed in Chapter Two, Balderston (1974) and Eble (1978) describe how institutional values influence decision making and management in higher education. Insti-

tutional values also influence computer use. Culture's influence is visible in two ways. First, it directly affects what the institution does with computing. This is apparent in institutional values that support and oppose computing, in the overall way in which each school uses computer resources, and in the computer-related programs at those schools which offer such courses. Second, culture influences the people who provide and use computing. It affects the orientation of computer staffs towards users and the attitudes of users themselves.

Culture and Use. The histories of the institutions and their computing efforts illuminate the value the colleges place on computer use. The value of computing has been strongly and clearly articulated at Wellesley. The college is beginning to value computing as it is at WPI. Administrators and faculty are beginning to think of computing as an essential part of their educational offerings. At Simmons computing is another practical skill. It is an area of knowledge that supports the students' career goals. The lack of action taken to promote computer use at Regis demonstrates that the college does not value computing highly.

Not all of an institution's values may support computer use, which may lead to opposition to computing. Administra-

tors at Babson, for example, value financial solvency over some educational goals, and they have thwarted the faculty's efforts to expand the school's computer facilities. New administrators concur with the faculty and value educational computing goals. It appears that this shift in beliefs will affect computer use. Proponents of computing at Wellesley fought strong beliefs that computing is a technical or vocational skill inappropriate in a liberal arts setting. Part of their computer literacy strategy was to change these opposing beliefs.

The values, beliefs, and mission at each school influence how the colleges use computers. Each institution uses and promotes computing that is congruent with its culture and supportive of its fundamental goals and saga. This is most obvious in the overall use of the resource. Computing is a necessity at WPI and the school treats it as such. Faculty members at Babson believe that computing is a necessary field of knowledge for today's business students. It is part of the modern manager's tool kit. Simmons stresses combining practical computing skills with liberal studies and Wellesley emphasizes integrating computing into the liberal arts.

The influence of sagas is apparent in the computer-related programs at the schools. The institutions with com-

puter programs or majors have matched them with institutional saga. Applied Computer Science at Simmons joins practical skills and liberal arts. Regis will have a short series of courses that satisfy the career interests of its liberal arts students. Wellesley's computer science major will preserve the characteristics of the liberal arts. None of these schools designed a highly technical major such as the computer science program at WPI.

Culture and Personnel. Organizational culture also influences the people who provide and use computer resources. It shapes the values and beliefs of computer personnel. This is apparent in their orientation towards computing. Staffs members tend to be either "machine-oriented" or "user-oriented." The clearest example of machine orientation is WPI. Jackson does not feel that he needs to provide extensive user support. He thinks of WACCC as a technical service bureau. The institution's culture supports this. Similarly at Babson, where computing is a tool for use in specific disciplines, more personnel support the computer than the users. There is less emphasis on user support and encouraging new use. The computer center staff is reactive and has assumed that users will take the initiative. Wellesley is at the other extreme. Ott tries to be as user-oriented as possible. His staff makes every effort

to accommodate and support users. This illustrates Wellesley's motto at work. Personnel structure does not determine these differences. Rather, they arise from institutional values and mission.

The computer personnel's orientation has a varied influence on different groups of users. Younger faculty members, for example, are more likely to have used computers during their own educational training. Hence they are more likely to use computers for instructional or research tasks, and less likely to need user-oriented personnel. Computers may intimidate older faculty members because they are less familiar with the machine and it is not part of their experience. They need greater user assistance. Yet it is the older, more senior faculty who need to support computer use if it is to flourish on the campus. This is why Wellesley placed greater emphasis on getting tenured faculty to participate in the Sloan workshops.

Faculty who begin to use computer resources for one purpose often become computer converts. Many individuals use the word convert, a term that connotes a change in underlying values and beliefs, to describe this phenomenon. Once faculty use computing for one task, their beliefs about computing change because they understand its value. Faculty become interested in what the resource can do for them and

use it for an increasing variety of reasons. They demand computer resources which they feel are a necessity. They often share their enthusiasm with colleagues. The "convert" phenomenon illustrates the reciprocal relationship between use and organizational culture. Changing patterns of computer use influence the values and beliefs of the organization's members.

Culture and Structure. It is also tempting to speculate on culture's influence on structure. These connections are much more complex, but they are visible nonetheless. Administrators at Babson, for example, have valued sound managerial and fiscal policies. These values influenced the decision to found ACCOMP and to have Canty report to the financial vice-president. Similarly, beliefs about computing influence allocation policy. Each college believes that students and faculty should have free access to computing. The institutions forfeit a large degree of control over computer resources because of this value. Even under conditions of scarcity the belief takes precedence over more practical considerations such as restricting use to control demand.

Computer Stage Theories Revisited

As discussed in Chapter Two, several theories suggest stages in the growth of computing. Administrative computing functions in higher education follow the stage development theories. Administrators learn how they can benefit from information systems and data bases, and they use them increasingly. Computers become a necessity once introduced. Over time, data management becomes more important than technology.

The stages are not as clear for academic computing. In scientific disciplines and technical colleges such as WPI, computer use continues to expand. Users demand better services and facilities. The stages of growth are visible. But many disciplines need constant support and encouragement to maintain computing efforts. Babson, for example, recently discovered the decreased penetration of computing. Without constant "evangelical" efforts, as Ott at Wellesley says, computer use declines. Those who are not familiar with computing do not readily see its applicability to their work. In this important respect, academic use differs from administrative and business computer use.

In one significant way, however, academic computer use does parallel Nolan's stages. The last stage is interest in information management rather than computer management. As

academic users become familiar with the resource, they become more interested in what it does. Information and its use are the focus. Technology becomes less important than the tasks it can perform.

The low priority given to managerial issues such as allocation is an example of the interest in ends rather than means. Educational philosophy, not managerial control, governs allocation policy. Even when changes in allocation policy might relieve pressures on an overburdened computer system, colleges are hesitant to move away from a free access philosophy. They value the educational goal more than the practical means of control. This reflects what each school wants from its computer resources. The schools make computing available to meet educational needs.

There is a fundamental difference between academic and administrative computing that explains the limitations in the stage theories. In most business or administrative applications there is a specific task for the computer. It may be billing accounts receivable, maintaining alumni mailing lists, or monitoring student applications. In such cases the task and need are fairly obvious. The business literature on managing computer operations and Nolan's stages are also task oriented. In academic use, however, the task is more ambiguous. It is much less readily appar-

ent how to apply computer resources in some academic disciplines. This is particularly true when faculty are not familiar with computer resources.

Suggestions for Other Institutions

Because of the ambiguity and lack of knowledge that often accompany the introduction of computer resources, colleges which make an integrated effort to introduce them will promote use to a greater extent than schools without such an effort. An integrated effort means that the college does more than just make the resource available. It acts in a coordinated fashion and supports the introduction of computing with faculty education and user support. Part of the integrated effort is structural. The institution must have knowledgeable personnel, facilities must be available in a consistent manner so users can rely on them, and allocation must be fair and understandable. But cultural changes must accompany the structure. Two means are available to do this. The instutition needs someone to help integrate the resource into the campus and a program to encourage use.

The Role of Integrator. Removing or reducing the barriers between organizational members whose cultures differ is a real need. Lawrence and Lorsch (1967) describe an inte-

grating role in organizations. Their integrator is a communication link and translator between different departments or divisions within a business. They found that as two departments become more dissimilar, need for the integrator increases. Welsch (1981) describes a similar role in the successful implementation of computerized decision support systems.

An integrator role is also necessary in computing. When there are few differences between the user and the technical nature of computing, there is little need for an integrator. In many cases, however, an essential part of developing computer resources involves bridging the perceived gap between user and technology. Many potential users do not understand computing and do not know what functions the resource might serve. Computing retains a high degree of mystery. Technicians tend to talk and write in jargon. The machine's mysterious qualities have also been exaggerated in part because of its physical needs. Computers have been isolated in carefully controlled environments. Integrating computers into a campus requires removal of these perceived barriers. Without an integrator institutions must rely on individual users to make the effort themselves. This requires a high degree of motivation. Actively providing assistance is a tremendous help.

The integrator serves several functions. This individual bridges the gap between the two worlds. He or she removes much of the mystery from computing. The courseware specialist at Wellesley performs this role. Some of her job is practical. It involves translating jargon, interpreting instructions, and simplifying the technology. The integrator must be familiar with the technical aspects of computing.

But an equally important portion of the integrator's job is cultural. The integrator must change the user's beliefs about computing. Through this individual the user learns that computing can be a useful and valuable tool. The integrator converts the user. A highly technical individual is unlikely to succeed in the role. The integrator must understand the user's cultural perspective and proceed from the user's orientation.

Encouragement. The integrator encourages computer use. Other forms of encouragement are also beneficial. In the simplest form, the institution can train those who want to learn more about computing. It can make the resource readily available through a generous allocation policy. In order to promote use the college must also make faculty aware that it values computing. If the institution talks about computer use but does nothing to encourage it, faculty

have less incentive to become involved. When it is clear that computing is an integral part of the college's educational program, more faculty will use computer resources.

Summary

The structural elements described in Chapter Two, personnel, facilities, and allocation policy, affect computer use. The literature identifies issues that influence the scope and nature of computer use in higher education. Improper attention to these factors has adverse consequences for computing. But the literature ignores the influence of organizational culture. Every institution is unique. It has its own values, beliefs, and saga. Computing is enhanced when efforts are congruent with or take advantage of organizational culture. These concepts explain why schools use computing resources in various ways. They illuminate why users view the resource differently on each campus. They explain why institutions develop distinct computer-related curricula.

Administrators who are responsible for computing can take several valuable lessons from this research. As the literature recommends, structure should be congruent with computing needs and there are many ways to achieve this.

Structure should also change as needs change. Administrators must also be aware that structure is not the only organizational influence on computer use. Effective structure is necessary but not sufficient. Administrators must acknowledge the influence of organizational culture on their campus. They should try to articulate the institution's beliefs, values, and saga. They should examine them to determine how they affect computer use and personnel. They should plan new programs, courses, and computer-related initiatives so that they are compatible with the institution's culture.

Appendix A

Institutional Characteristics

	WPI	Babson College	Simmons College	Regis College	Wellesley College
Location	Worcester, MA	Wellesley, MA	Boston, MA	Weston, MA	Wellesley, MA
Founded	1865	1919	1899 (chartered) 1902 (opened)	1927	1870
Affiliation	Independent	Independent	Independent	Catholic	Independent
Endowment (Millions)	39	9	20.6	N.A.	142.5
Degrees Offered	BS MS PhD	BS MBA	BA, BS MA, MS, MP MAT, MSW DA	BA, BS	BA
Number of Majors	18	11 4 Joint	19 5 Inter-departmental	15	26 Interdisciplinary
Faculty	201 full-time 46 part-time	93 full-time 24 part-time	167 full-time 100 part-time	55 full-time 28 part-time	222 full-time 75 part-time

Institutional Characteristics

Appendix A

	WPI	Babson College	Simmons College	Regis College	Wellesley College
Enrollment	2400 undergrads 175 graduate	1370 undergrads 321 full-time MBAs 1422 part-time MBAs	1900 undergrads 895 graduate	1127 undergrads	2096 undergrads
Student Body	Coed	Coed	Women	Women	Women
Geographical Distribution of Students	33 States 47 Countries	31 States 42 Countries	24 States 12 Countries	18 States 16 Countries	50 States 51 Countries
Tuition (81-82)	$5,850	$5,360	$5,728	$4,025	$6,450
% Students on Financial Aid	80	33	38	78	72

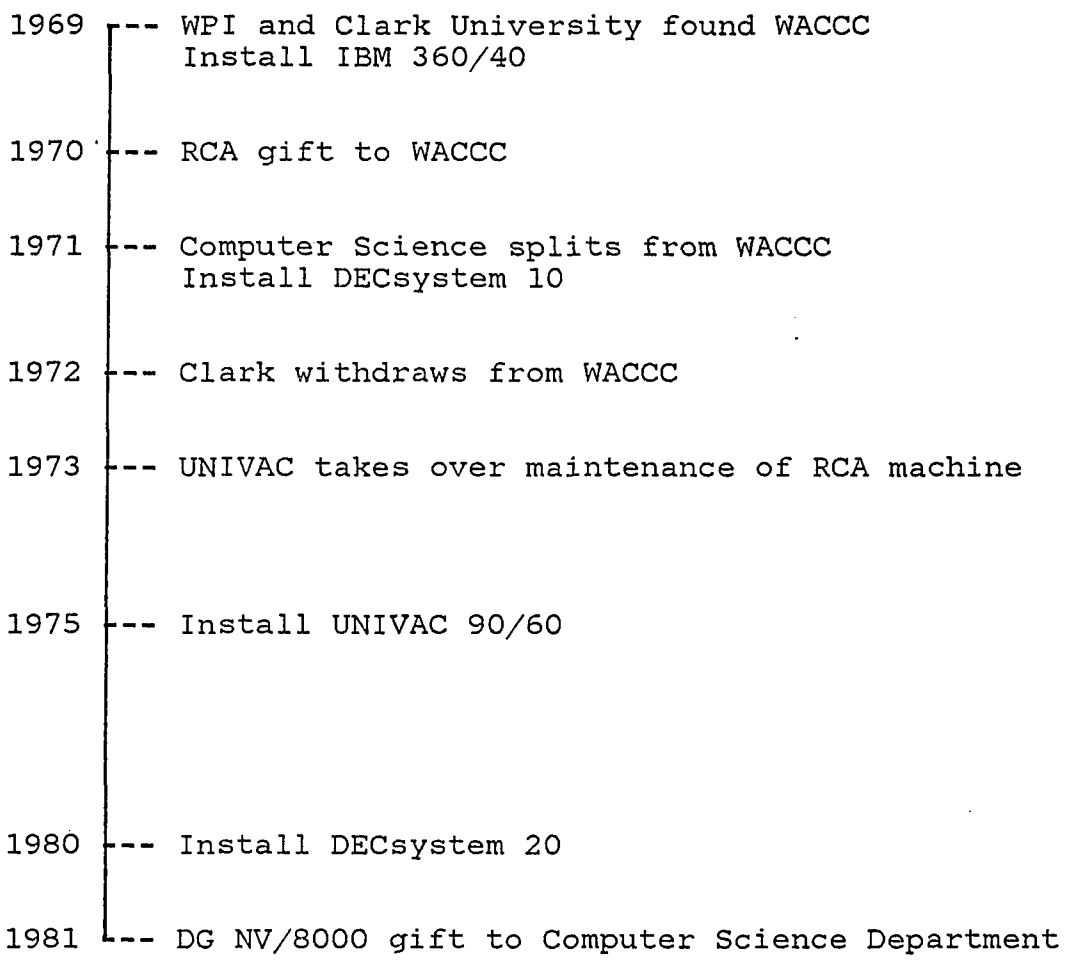
Institutional Characteristics

Appendix A

Appendix B

Case Time Lines

WPI


1969 --- WPI and Clark University found WACCC
Install IBM 360/40
1970 --- RCA gift to WACCC
1971 --- Computer Science splits from WACCC
Install DECsystem 10
1972 --- Clark withdraws from WACCC
1973 --- UNIVAC takes over maintenance of RCA machine
1975 --- Install UNIVAC 90/60
1980 --- Install DECsystem 20
1981 --- DG NV/8000 gift to Computer Science Department

Babson College

1967 --- First computer use in a course

1968 --- Mathematics Department hires Canty

1970 --- Babson founds ACCOMP
Canty reports to Putney, Financial Vice-President
Lease Hewlett-Packard 2000

1971 --- Found Inter-Colegiate Computer Society, Inc. (ISCI)

1972 --- Upgrade HP2000 to HP2000C'

1974 --- Hire Dixon as registrar

1975 --- Disband ISCI

1976 --- Install PDP 11/70

1978 --- Install VAX 11/780
Sell HP2000
Dixon becomes head of management information services

1981 --- Revitalization of faculty computer committee

Simmons College

1968 --- FORTRAN, batch facilities at MIT via NERComP

1969 --- Chemistry Department hires Soltzberg
Computer Appreciation course begins

1970 --- Simmons joins ACCOMP
Soltzberg chairs faculty computer committee

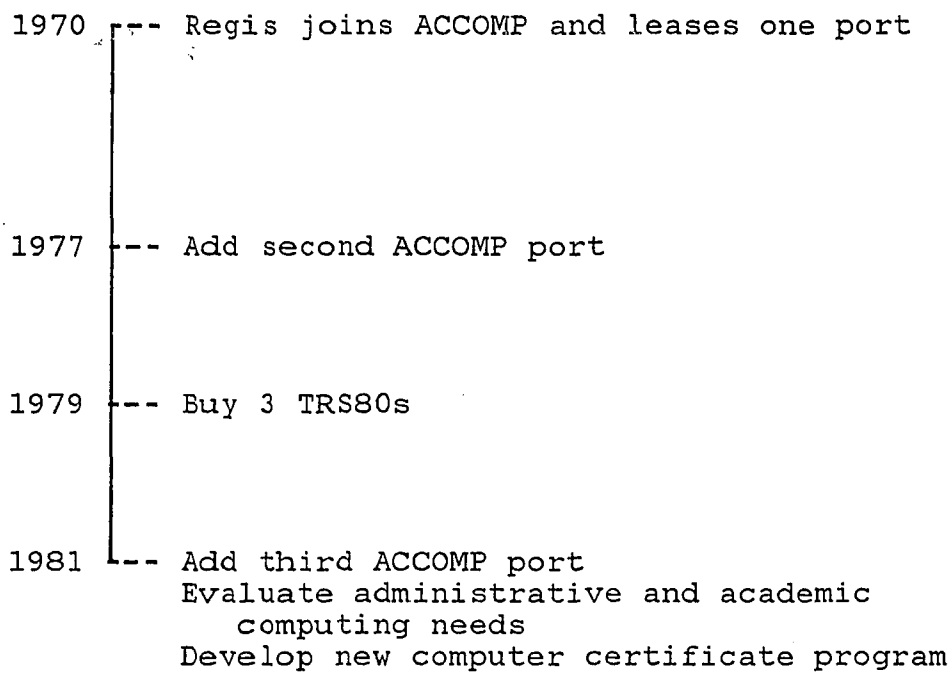
1976 --- Soltzberg becomes coordinator of academic computing

1978 --- Hire SCT for administrative computing
Purchase Hewlett-Packard 3000

1980 --- Simmons does not renew SCT contract
Soltzberg made part-time director of administrative computer facility
Purchase "Apple Cart"

1981 --- Faculty approves Applied Computer Science
Install PDP 11/34

Regis College



Wellesley College

1969 --- Use batch facilities at MIT

1970 --- Join NERComP to use a variety of computer resources

1975 --- Build Science Center
President Newell asks Kolodny to investigate computer literacy
Kolodny forms faculty committee
Ott becomes director of academic computing

1976 --- Use CAUSE grant to purchase DECsystem 2040
Faculty committee becomes ad hoc

1978 --- Sloan workshop for Social Science faculty

1979 --- Sloan workshop for Natural Science faculty

1980 --- Sloan workshop for Humanities faculty
NERComP consultants examine administrative computing

1981 --- Hire Blackwood as manager of administrative data processing
Purchase Prime I5000 for administrative use
Upgrade to DEC-2060

Appendix C

Research Methodology

I faced several problems when designing my research methodology. I wanted to explore the relationships between organizational structure, organizational culture, and computer use. I did not know what I would find and what form any relationships might take. The ambiguous nature of one of the concepts, organizational culture, compounded the problem. Finally, I wanted to examine a broad range of institutions, but I had to do so on a limited budget. My methodology reflects these concerns.

Sample. The sample consists of five colleges within an hour's drive of Cambridge which use computing in diverse ways. Worcester Polytechnic Institute uses computing in technical and applied science programs. Babson College requires a computer course of its management students. Simmons College combines practical computing skills with liberal arts. Regis College has done little with computing, but it is developing a sequence of computer courses for its liberal arts students. Wellesley College is integrating computing into its liberal arts curriculum. A major weakness with the case study approach is the question of gener-

alization. By selecting sites that differ widely on several dimensions, I hoped to reduce this problem.

At each site I initially contacted the individual responsible for academic computing. I explained that I wanted to study organizational influences on computer use and what cooperation I needed. I also determined who else I should ask for permission to conduct my research. At Regis, Wellesley, and WPI further approval was not necessary. Canty at Babson and Soltzberg at Simmons both sought approval from their superiors. McKee at Simmons asked that I limit my research to academic computing. I did this, but eventually discussed administrative computing with McKee and Holmes. Many other individuals at Simmons volunteered comments on administrative computing.

Data Collection. Semistructured interviews were the primary means of data collection. I identified about half of the respondents from their official roles on the campus. Such individuals included computing staff, directors of admissions and alumni affairs, and academic deans or vice-presidents. I also used snowball sampling techniques (Murphy, 1980). I asked respondents who else on the campus I might interview. I was particularly interested in identifying faculty computer users, members of computer committees, and whoever else might be involved with computing or be

knowledgeable about the institution. I conducted the interviews in the respondents' offices.

I used a "funnel sequence" of questioning (Gorden, 1971). I began with general questions and moved to more specific topics. The sequence and topics varied by subject. Most questions were open ended so that respondents could answer my questions while providing clues about what they thought were important points (Lofland, 1971). I started with questions about the history of computing for those who knew such material. I moved to current practice and problems, and finally to a discussion of the institution itself. For those less knowledgeable about computing, I focused on the institutional questions. I referred to an interview guide that listed the topics I wanted to cover to ensure that I gathered comparable data at every site. I remained flexible, however, to take advantage of each respondent's natural progression of topics.

I took extensive notes during each interview and asked the respondents if this was acceptable. In addition to the conversations, I noted points for further questioning and made marginal notes on the respondents' reactions to my questions. I did not take notes if a respondent said that something was off the record. After each interview I reviewed my notes, clarified them, and added additional com-

ments from memory while the interview was still fresh in my mind. I used a different color pen when I reviewed the notes so that I could later distinguish between my original notes and what I added or elaborated upon. I called the respondents if I came across any unanswered questions or needed additional information on any topic.

Questions about computing were straightforward. I asked respondents about the history of computer use: when and how use began, who was involved, how it developed over time, and what problems, if any, arose. I asked about allocation methods, equipment acquisitions and upgrades, staffing, user support, and faculty encouragement. Computing staff responded to questions about types of computer use and the faculty's and students' experiences with computing. I probed faculty about their use of computing, how they became involved with computing, and how their students react to computer assignments. I encouraged respondents to elaborate and clarify their answers as necessary.

Uncovering information about organizational culture was somewhat more difficult. I used a pivotal question (Gorden, 1971) to change the direction of the interview. I told respondents that I was interested in learning more about the institution and "what kind of place it is." I did not say that I was interested in organizational culture. I asked

respondents to talk about "what makes their institution unique or distinct," "how it differs from other schools," and "its educational philosophy." I asked respondents to characterize the student body and alumni. Finally, I asked if they could identify any person or persons who were important in the history of the college, who had resolved some crisis, or who upheld what the institution stood for -- I asked them to identify institutional heroes. I also listened for references to the respondents' attitudes, values, and beliefs. Interviews are an excellent means of obtaining such information (Smith, 1981). While respondents often proceeded with little prompting in their discussions of computing, I had to give more encouragement for the cultural questions. Often I had to assure them that their answers were helpful. Respondents sometimes had difficulty articulating their thoughts, but most were able to provide useful cultural data.

Document analysis (Webb, Campbell, Schwartz, Sechrest, and Grove, 1981) provided additional information and was a reference against which to check the accuracy of data gathered in the interviews. I was particularly interested in statements about the college's mission or goal. These appear in official publications and self-studies for accreditation. Recent inaugural addresses stated current direc-

tions and goals at Babson and Wellesley. While platitudes are common in such documents, I could determine if these statements matched what I heard in the interviews. Wellesley had extensive documentation of its grant proposals and evaluations of computer literacy. Babson and Simmons both had annual computer reports that described changes over time. Computer staff members at Simmons and Wellesley had papers on their approaches to computing which they had presented at professional meetings.

I had hoped to obtain more budgetary information than I did. Administrators were wary of providing detailed budgets because they feared misinterpretation by individuals on the campus if the information became known. Often their concern focused on salaries paid to computing staff and differences in the resources allocated to administrative and academic computing. While detailed budgetary data would be helpful, it was not available for my analysis.

My final source of data was information kept on computer use. This included items such as connect hours, number of users, and number of courses using computing. Such information was surprisingly difficult to obtain, however. Wellesley, because of its grants and interest in evaluation, had the most detailed data about levels of computer literacy. Simmons had information about connect hours for each depart-

ment. Babson kept track of the classes that requested computer accounts, but only last fall began recording how much computing each one actually used.

Bias and Error. Bias is always a risk in organizational research. The use of several data sources reduces this somewhat. I could check the accuracy of factual information obtained in interviews against the documents. I also used interviews with different individuals to confirm data. The variety of respondents in each organization gave different perspectives on the same issues. If one respondent's statements did not match what I heard elsewhere, I would probe that issue. Thus triangulation between subjects and data sources served to confirm critical information (Denzin, 1970). In most cases there was close agreement in the responses to my questions. When differences arose, they almost always concerned controversial topics. They provided clues about the sensitive nature of the material I was probing (Salamone, 1977). I was particularly careful to triangulate on the cultural data. I checked perceptions and beliefs against each other. I noted if I was hearing different institutional stories from different individuals on each campus.

Analysis. Data collection and analysis were concurrent activities (Lofland, 1971). When I finished each interview, I thought about what I had heard and how it related to what I had already discovered. I made notes to myself about possible hypotheses. After I finished the interviews at each site, I copied my notes to five by eight inch note cards. I used different color cards for each site. In transferring the notes I separated topics by card. Allocation was on one card and use on another, for example. I labeled each card with the appropriate topic in the upper-right-hand corner. I also grouped the data by class of respondent. I placed data from the computing staff, top administrators, other administrators, faculty, and documents on different cards. I used five colors of ink to identify these groups. Finally, I noted which respondent had provided the information. Thus I could easily sort the cards by site, topic, respondent group, respondent, or any combination of these factors.

The process of transferring the data to cards forced me to discover the significant classes of information in the data (Schatzman and Strauss, 1973). These were the categories that emerged from the data. I could then look at each grouping and link them together in ways that made sense according to the organizational concepts I was interested

in. From the first order facts I could draw second order theories (Van Maanen, 1979). I looked for trends and generalities at each site and then compared them to what I found at the other sites.

References

Interviews

Babson College

James Almeida, Student Computer Assistant

Jeffrey R. Alves, Assistant Professor of Finance

Leslie D. Ball, Associate Professor of Mathematics and Faculty Computer Committee Chairperson

Edgar T. Canty, Director of Academic Computer Services

Joseph B. Carver, Director Undergraduate Admissions

Melvyn R. Copen, Vice-President for Academic Affairs

George T. Dixon, Director of Management Information Systems

Robert J. Eng, Assistant Professor of Marketing

Joseph E. Mahoney, Director of Alumni Relations

Arthur Mann, Coordinator of Computer User Services

William C. Nemitz, Assistant Professor of Management and Organizational Behavior

Jesse M. Putney, Vice-President for Business and Financial Affairs

Harvard Business School

James I. Cash, Assistant Professor

Christopher Nugent, Director of the Division of Computer Services

Regis College

Paul F. Eaton, Director of Admissions and Financial Aid

Edward J. Mulholland, Academic Dean

Simmons College

David Browder, Associate Professor of Mathematics

Anne Coghlan, Dean of Science

Martha Davidson, Director of Library Technical Services

Mary Jane Doherty, Director of Alumnae Affairs

Caryl Goodman, Assistant Professor of Sociology

Susan Harris, Student Computer Consultant

William J. Holmes, President

Mary Helen Kuhns, Associate Director of the Computer Facility

Lisa Linhart, President of the Student Government Association

Linda Cox Maguire, Director of Admissions

Lisa Mayer, Director of Financial Aid

Priscilla L. McKee, Administrative Vice-President and Assistant to the President

Margaret S. Menzin, Professor of Mathematics and Coordinator of Applied Computer Science

Edward Prenowitz, Associate Professor of Physics and Coordinator of Applied Computer Science

Leonard J. Soltzberg, Professor of Chemistry, Director of the Computer Facility, and Faculty Computer Committee Chairperson

Kathy Sullivan, Student Computer Consultant

Wylie Sypher, Professor of English Emeritus

Wellesley College

E. Anne Blackwood, Manager of Administrative Data Processing

Maud H. Chaplin, Dean of the College

Hsiao-ti Falcone, User Services Coordinator

James H. Grant, Assistant Professor of Economics

Roger A. Johnson, Professor of Religion

Nancy H. Kolodny, Associate Professor of Chemistry

Eleanor D. Lonske, Courseware Specialist

Anne Morgan, Executive Director of the Alumnae Office

Gene Ott, Director of Computer Science

Eric Roberts, Assistant Professor of Computer Science and Mathematics

Audrey Smith-Whitaker, Associate Director of Admissions

Theresa Yao, Lecturer in Chinese

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William R. Grogan, Dean of Undergraduate Studies and Professor of Electrical Engineering

James J. Jackson, Director of Worcester Area College Computer Center (WACCC)

Roy A. Seaberg, Director of Admissions

T.C. Ting, Head, Department of Computer Science

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