Basic changes in the economics of libraries are forcing librarians to look at innovative strategies to achieve cost-effective operations. A major problem confronting librarians is how to allocate resources, reduced by budget cuts and inflation, to satisfy an increasing user demand for more responsive library service. The economics of information and the economics of innovation are relatively new fields of study. There are no theories or recipe books to which one can turn for solutions to problems in library resource allocation or library innovation.

In the past, innovation in libraries was focused primarily on products of technology. Three recent developments—automation, low-cost rapid communications capability, and demands for better managerial performance—have led to a broader concept of innovation, which is centered on processes, functions and human behavior. Drucker states: "Innovation is not a technical term. It is an economic and social term. Its criterion is not science or technology, but a change in the economic or social environment, a change in the behavior of people as consumers or producers, as citizens, as students or as teachers, and so on."1

Innovation does not happen by chance. It is a deliberate and specific change which is introduced in response to changes in the library's external environment, or to help the library accomplish its objectives more effectively.

This paper is concerned solely with the economics of innovation in academic libraries. The social and managerial aspects, while important

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to the use of innovative strategies in libraries, will not be considered. The purposes of this paper are to present: (1) a review of the economic literature dealing with innovation, (2) a review of the economic environment and structure of libraries and their relationship to innovation, (3) a discussion of sources of capital for libraries, (4) the economic character of innovation, and (5) innovation in libraries.

THE LITERATURE OF INNOVATION

The literature of innovation reflects study from two major perspectives: economics and sociology-psychology. Economics treats innovation as a matter of the diffusion of technology, technology transfer, economic development and growth, etc. Past studies typically aimed at determining the optimal scale for business firms engaged in the manufacture of some product, or at exploring the most effective industrial organization in terms of its structure/conduct/performance features with respect to standard economic criteria. The second approach, that of sociology-psychology, examines the processes of social change and cultural diffusion. Typical studies examined these processes in developing nations, within mature societies, or as a part of organizational development in bureaucracies or government. The type of innovation generally discussed is a shift in the structure and function of human relationships in a social system, and in the institutional sector or organization.

Rarely have these two perspectives been unified, nor has either perspective been used extensively and directly in the analysis of innovations affecting the information industry. This lacuna is puzzling, because in many ways information activities are a major factor in the innovation process.

The current consensus among economic theorists is that while the topic of innovation is receiving important and systematic analysis, a general theory has yet to emerge from prior and current work. Until very recently, technological and social changes were treated as exogenous variables in standard economic analysis. However, the impact of technological change has become so pervasive and is such a major determinant of economic conditions that innovation is a topic now in demand, as evidenced by the increasing number of publications by economists attempting to analyze innovative phenomena.

That innovation is an important factor in today's society is evident in the amount of attention the government is paying to this issue. The Carter administration has initiated a policy study regarding industrial
innovation, with a top-level committee charged with developing a set of policy options aimed at removing barriers to innovation. This was recently announced by Dr. Frank Press, science advisor to President Carter and Director of the Office of Science and Technology Policy.2

Librarians should find the following brief review of the literature on the economics of innovation useful background for increased understanding of library innovation.

A concise, informative review of the literature of innovation from the economist's perspective is found in the recent article by Nelson and Winter. The authors concluded that current understanding of the subject is far from the "handbook" stage, with major policy issues unresolved and theory deficient in explanatory power.3 However, this wide-ranging and thorough review constitutes a good introduction to economic thinking about innovation.

One of the best general introductory works to the topic as treated by economists is by Heertje;4 he takes a historical approach at a level which librarians unfamiliar with economics can follow without encountering excessive mathematics. Heertje's discussion of public policy issues relating to guidance and control of technical development is especially relevant to library innovation.

The managerial implications of the process of technological change are covered by Gold, with an especially interesting chapter by Pierce on the unexpected ripple effects accompanying shifts in technology.5 Pierce notes that second-order consequences often go far beyond the initial frame of economic analysis regarding a proposed innovation.

Parker6 provides a more advanced treatment of the economics of innovation in manufacturing industries, the typical focus of most economic studies up to this time. Innovation in the public sector is given relatively short shrift, although Parker's introduction and general treatment of the topic suggest broader implications.

Other studies include a wide-ranging review of technical innovation stemming from the initial three years of the National Science Foundation's research and development incentive program, published as a set of twenty-six papers edited by Cunningham and others.7 Myers and Sweezy have reported on a recent study of 200 cases concerning the reasons innovations fall short of commercial development.8 Roessner discussed the incentives for innovation in both public and private organizations.9 The process of diffusion of innovation in the public sector is discussed by Feller and Menzel,10 as well as by Bingham,11 and in a
report by the Stanford Research Institute. Policy issues regarding technical innovation in the public sector are reviewed by Roessner.

A good introduction to the sociology-psychology perspective on innovation and social change can be found in Zaltman and Duncan, who survey what is known about diffusion of innovation and organizational change, especially the change-agent approach to innovation, and principles or guidelines for facilitating social change. A collection of readings by Zaltman and others offers further background on the general topic. Of special interest to librarians is his application of this perspective to the education sector. Greeer uses the same general approach in studying health care — another public sector activity in which innovation studies offer librarians useful lessons. An article by Garvey and Gottfredson treats social changes in scientific communication.

This literature review did not uncover any articles which treat innovation in libraries per se. However, some efforts have been made to inventory reports of research projects featuring innovation in libraries and librarianship or related institutions. Perhaps the best known of these is the compendium by Wasserman. McLean compiled a directory of field experience in academic library innovation in Ohio. A 4-volume forecast of technology for the scientific and technical information communities is provided by Nisenoff and Clayton, who developed a unified body of data representing "best judgment" forecasts of communication system performance, cost and availability over the next twenty-five years, also considering usage patterns and needs of representative user groups in the scientific community. A doctoral dissertation by Howard explores relationships between organizational factors and the rate of innovation in university libraries, drawing primarily on the sociological perspective as the basis for analysis.

Recent library topical conferences are among the most effective means of surveying actual cases of innovation, as well as the pressures and opportunities for innovation in libraries. Among the most relevant, recent in-print proceedings are those edited by Kent and Galvin in which the chapter by Cohen is particularly interesting in its application of economic analysis to help guide library change, and by Divilbiss which also provides considerable economic perspective regarding library innovation. Appropriate chapters in the Annual Review of Information Science and Technology serve as an excellent source of leads regarding innovative efforts in libraries and related organizations.
ECONOMIC ENVIRONMENT OF THE LIBRARY

This section will discuss the economic environment of the library in terms of the critical factors affecting library operations and their relationship to innovation. The economic environment of the academic library is defined in three areas: (1) the external environment, in which economic factors are beyond the immediate control of the library; (2) the university setting, in which the library has input and influence; and (3) the internal operational environment, in which the library has varying degrees of control over the allocation of economic resources.

External Economic Factors

The economic elements in the external environment which have the greatest impact on academic libraries are population, government funding, prices and technological developments. The size of the college-age population has had and will have a significant impact on the quantitative demand for library services. Estimates by the National Center for Education Statistics indicate that total enrollment in 4-year institutions of higher education will peak at just over 8 million in 1981 and decline to 7.6 million in 1985.\textsuperscript{25} Enrollment declines are likely to continue beyond 1985 because of continuing low birthrates and trends toward smaller families. The number of instructional staff also will decline.\textsuperscript{26} These decreases will result in smaller primary client populations for most colleges and universities and a reduction in quantity of instructional material and services demanded. In some academic institutions the demand may be altered rather than reduced because of increased volume of research or continuing educational activities.

Federal funding for academic libraries cannot be projected with accuracy at this time. Tax cuts at the federal level will force public policy priorities which may not leave large amounts of funding for libraries. State-supported colleges and universities may be subject to severe financial hardship as enrollments decline and state tax levels are frozen or reduced. There is no clear definition of the responsibility of each level of government to fund libraries.

At the same time, there appears to be no end in sight to inflation of wages and library materials prices. Halstead has estimated that prices paid by colleges and universities for goods and services have increased 101.3 percent since 1967. During the same period, the average price of U.S. periodicals increased 210.9 percent, and the average price for hardcover books, 165.7 percent.\textsuperscript{27} This loss of purchasing power, coupled with prob-
able decreases in funding, will force librarians to seek innovative strategies to satisfy demand with increased efficiency.

Within the foreseeable future, computer hardware will be available to most libraries. It has been estimated that over the next decade computer logic costs will drop 25 percent per year and computer memory costs will decline 40 percent per year. Advances in data base management systems and networking will make computer-based systems affordable even for the small library.

Faster and cheaper communications will facilitate resource-sharing among libraries. Communications costs are expected to drop 11 percent per year. This decline is likely to result in greater use of both tele-facsimile transmission of documents between libraries and electronic communication, with a corresponding decrease in paper communication.

Institutional Setting
As income from tuition declines, colleges and universities will be seeking additional funding. Gifts, endowments and sponsored research will be the primary sources. In the past, the volume of corporate and alumni gifts has been closely tied to the state of the general economy. The uncertain economic outlook, especially in areas of inflation and corporate profits, indicates that gifts may not be a reliable and steady source of funds. Income from endowments also may be insufficient to offset revenue losses. Competition for limited research funds will be greater. The gap between actual revenue and needed revenue is likely to grow.

Colleges and universities will be forced to examine their resource allocations among teaching, research and support activities. All units within an institution will be forced to adopt more efficient, cost-effective methods. Cyert has pointed out that: "The only source of increased resources is likely to result from the internal management. The technique is to find ways of achieving approximately the same quality level of services or activities... but achieve it with fewer resources." Librarians need to be aware of both the political and economic thinking taking place in university administration. In a highly competitive and political environment, increased library funding may be difficult to justify. Libraries caught in the double bind of reduced funding and continuing inflation will have no choice but to adopt innovative strategies to increase internal resources in order to satisfy user demand.

Internal Library Operations
The increase in internal resources for the library will depend on the library's ability to increase staff and user productivity. While the quan-
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tity of demand for traditional services may decline, the quality of service demanded may be greater. As faculty spend more time writing grant proposals and journal articles, they will have less time to spend in the library. They will require easier, less time-consuming access to bibliographic and substantive data. Library operations which are highly labor-intensive will have to be converted to computer-based systems to reduce the rate of increase in unit costs and to increase productivity. With labor costs increasing 6-7 percent per year, it will not be possible to continue operation of purchasing, cataloging, bibliographic information, document delivery or communications systems in a manual mode.

It should not be inferred that technology alone will solve the library's operational problems. There is a great need to understand more fully the fundamentals of library service and the nature of user needs. Librarians will have to become more knowledgeable about consumer demand, the uses of information and the value of information to the user. In his statement of the problem, De Gennaro said, "It is becoming increasingly clear that the long-term solution to the chronic fiscal, staff, space, and other problems besetting research libraries lies in setting aside the old models of Harvard and Yale and developing new and more realistic sets of goals."

Initial applications of technology will provide substitutes for manual methods of processing, filing, accessing, etc. Zisman states: "The emphasis will be on the development of tools... We will mechanize tasks that people perform... but not automate the functions that they perform." As automation develops, it will be necessary to focus attention more on library processes and goals and less on books and devices.

Resource allocation in many institutions of higher education has been based on tradition and politics, and has lacked rational planning. In the past, colleges and universities have not articulated goals, priorities or a framework for resource allocation. In some institutions, libraries have received a consistently generous share of available funds, while in others the share has either been small or varied from year to year. Cyert points out that, "Without a clear understanding within the organization of a set of goals and the set of priorities designed to implement those goals, there will always be ambiguity and arbitrariness in the resource allocation process."

The economic conditions discussed earlier could force a change in decision-making processes at colleges and universities. Administrators will be looking for ways to increase productivity and efficiency while reducing overhead. Since libraries are part of overhead and likely candidates for reduction in funding, it will be essential for librarians to under-
stand the internal economics of the library, the relationship between input and output, and the concepts of investment and innovation.

SOURCES OF CAPITAL

As indicated earlier, libraries will have to change with the environment. High labor-intensity and massive collection-building are no longer affordable even by the richest library. Innovative strategies to reduce the rate of increase in unit costs and to make off-site resources available are essential. Resource-sharing and automation are two strategies likely to be integrated into the library of the future. Both strategies require capital which may not be available in the traditional library budget. In order to produce necessary capital, libraries will need to change their approach to budgeting, seek capital from the administration, and possibly charge user fees.

While various library programs have been government-funded, it is not certain that this funding will continue. Libraries must compete with other programs for funding at all levels. While librarians and the public may believe that libraries are socially good, the amount of money that policy-makers are willing to commit to libraries may be severely limited.

Many college and university libraries have instituted user fees to provide revenue for services such as bibliographic data base searching, interlibrary loan and photocopying. The fees may cover all or only a portion of the cost of these services. A study conducted by Forecasting International indicated: "Both librarians and users regard it as more acceptable to charge for automated services. The rationale is that one is paying not for basic service, but for improved speed or efficiency, new products, or expanded access capability." The extent to which libraries utilize service fees in the future will depend on institutional policy decisions.

THE ECONOMIC CHARACTER OF INNOVATION

Innovation entails major shifts in economic activity, usually driven by changes in the technology or economic environment of an industry or organization. The economic impact of innovation may be in one or more of three areas:

1. Shift in production function, i.e., a change in the mix of inputs needed to produce a particular output. The typical pattern has been to substitute some capital good (new technology involving machines) for
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some labor input, with the net effect of increasing the productivity of the unit time of labor.
2. Shift in outputs, usually with an increase in the choice of products and services available to consumers. This phenomenon can be dramatically pervasive: for some industries, over half their current range of goods and services did not exist a decade ago. Some innovations (e.g., lasers, computers, etc.) spawn entire new industries.
3. Shift in linkage of supply and demand regarding the funding mechanisms used to sustain an economic sector. Such innovations include improvements in market transactions via more efficient operation of the pricing mechanisms, or improvements in funding of nonmarket activity, via government policies regarding subsidy and taxation, or activities of private philanthropists who often perceive their role as promoting socially beneficial innovation. Often, nonmarket funding innovations focus on a more responsive linkage of supply to changes in demand.

The analysis of innovation often involves modeling the innovation process with a sequence of developmental stages: (1) the innovative idea, (2) innovation at one point, (3) subsequent adoption or diffusion elsewhere, and (4) emergence of second-order or "ripple" effects. Much of the literature focuses on efforts to accelerate the process of innovation (the adoption and diffusion stage). More recent analysis tends to distinguish the probable overall impact of a particular innovation beyond its initial source (the second-order effects).

Measuring the impact of innovation on economic activity is typically done through standard economic analysis. Recent studies have expanded the scope of analysis to include the impact of an innovation from new perspectives, e.g., how people spend their time, or the environmental conditions under which people live. Also, the ripple effects of technological change on the overall environment and on the interactions of one industry with another are topics of increasing interest. Recent economic studies suggest that an innovation's secondary effects are often more significant in the long run than its primary (initially expected) effects.

From a managerial perspective, librarians need to be aware that innovation involves uncertainty and risk. In seeking capital for investment, libraries compete with other academic services and teaching/research departments. The critical questions to be answered in the program selection process involve amount of money requested, expected payoff, risk
associated with the project, and uncertainty with regard to the future environment.

Managerial effectiveness is a major determinant of an innovation's success or failure. The ability of libraries to cope with uncertainty and to take risks is a key issue here, because the literature of librarianship suggests that librarians are averse to risk and antipathetic to the entrepreneurial role. Yet risk-taking behavior by librarians is certainly evident in recent literature: witness the large number of articles proclaiming how a particular library intends to automate in order to improve service or to attain more efficient operation. Unfortunately, these proclamations are rarely followed by articles detailing the success of these innovative projects in attaining their goals. Nor is the commercial sector immune to innovative risk in attempting to supply advanced technology to libraries. The most dramatic evidence of the risk involved in such innovation is the recent experience of Princeton University Library with 3M's automated circulation system which apparently ended in failure this past year. As a result, the system is being withdrawn from the market.

The innovation process needs to be based on firm understanding of the investment required, the economic or social impact on the library and its users, and the payoff for the college or university. For example, automation of some library activities will have greater impact on the production function than on the quality or quantity of output. Other innovations, such as document delivery services, will have the greatest impact on users.

The projected investment in and impact of innovation can be measured from a cost/output or cost/benefit perspective. The lack of precise measures of output need not be a stumbling block to addressing this issue. Anthony and Herzlinger point out that:

Benefit/cost analysis is feasible in only a small proportion of the problems that arise in nonprofit organizations, and these tend to be the well-structured and less important problems. By contrast, a benefit/cost way of thinking is feasible in approaching a great many problems. One of the characteristics of competent managers is that they look at proposals, at least in a general way, in terms of whether the benefits are probably worth more than the costs. They may not be able to quantify the relationship, nor do they need to do so in many cases. This way of looking at problems tends to distinguish the factors that are relevant from those that are not relevant.35
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There are few innovative strategies or technologies which are “sure things.” Any change in operations, goals or functions involves uncertainty and risk. While forecasts can provide fairly reliable data regarding the college-age population sixteen years hence, projections of the number of people who will actually attend college are more uncertain. A variety of economic and social factors could cause dramatic shifts in the proportion of college-age people who will enroll. The success of an administrative or technological innovation cannot be projected with certainty. While innovation may be directed toward more effective use of resources, there is no guarantee of success. Careful planning in innovation can reduce uncertainty to a risk which can be described in terms of probabilities.

INNOVATION IN LIBRARIES

The lack of a general theory of innovation inhibits any definitive statements regarding the future course of innovation in libraries. It is useful, however, to review expert opinion regarding the probable course of innovation in the publishing, communications and information industries and to note current trends.

Using the Delphi technique, Borko pioneered a study of research prospects regarding libraries and publishing in predicting the probable course of innovation.66 Also, a practitioner’s guidebook regarding current innovation in primary publication has been compiled by Capital Systems Group under contract to the National Science Foundation.57 Unfortunately, no similar manual has been compiled concerning libraries. In general, such efforts focus broadly on the information industry, rather than on the particulars of libraries per se. With the exception of the Ackoff study, which dealt with scientific and technical communications,58 very little use has been made of economic analysis in dealing with innovation in libraries on a broad scale.

A few instances can be found of economic analysis applied to particular innovations in libraries. Perhaps the most interesting recent example is an analysis of user fees as an innovation, done by Forecasting International, again under contract to the National Science Foundation.59 This project is supplemented by the recent work of Cheryl Casper in analyzing the impact of fee-for-service for particular library operations,40 and the work of Michael Cooper and Nancy DeWath in analyzing the impact of fees on an innovative service itself — data base searching in public libraries.41 Dougherty and Blomquist have done a pioneering study analyzing the impact of an innovation in library service (telephone re-
quest with at-office delivery of items) on consumer demand, although only a modest degree of economic analysis was used.\textsuperscript{42}

The economic environment of libraries described earlier, coupled with current and planned activities, suggests trends concerning the probable pattern of innovative activity for the near future. These trends are organized within a supply and demand context. Supply changes relate to inputs and prices of resources used by libraries to produce output. The most significant factors in innovation concerning supply are the size of the market and the sources of innovation.

The library market base for innovative research and development investment is too small to warrant major independent research and development effort for libraries. The sources of innovation are likely to be by-products or extensions of innovations created by or for the publishing, communications and computer industries. Innovations such as electronic mail and telefacsimile were developed primarily for industry and are being adapted for libraries.

Technological innovation will be provided to libraries—primarily by specialty suppliers adapting innovative techniques and devices to the particular needs of the library market—rather than pioneered within libraries. There are a few libraries located within large universities which can call upon the skills of engineers, computer scientists and others who will work with the library in developing new processes, techniques or devices.

Retrenchment of the economic base of higher education will constrain library program growth but accelerate innovation for efficiency. The name of the game is, do as much (or more) with less through labor savings. The current labor-intensive character of library service, and the propensity of wage rates to rise faster than the cost of computers and communications systems, will bring pressure to shift the library production function toward greater capital intensity.

Pressure for greater staff productivity will also push libraries toward increased reliance on consumer self-service as a primary mode of operation. Thus, currently popular programs of bibliographic instruction will be given economic impetus to expand and be changed to computer-based instruction as a means of increasing staff productivity.

Demand changes relate to shifts in output, consumer need and prices paid for library services. Changes in social, technological and instructional factors will generate a different but dynamic demand for information. The pattern and nature of these changes will vary among institutions. However, the ability of libraries to respond to these changes
in demand will greatly determine the size of the resource base which libraries can command through the market mechanism (fee-for-service) or nonmarket (subsidy) channels. In the past, most academic libraries enjoyed a monopoly position, with patrons using the library on the library's terms. Consumer awareness and competition from information brokers and free-lance librarians have eroded the monopoly position. A key issue will be whether the impact of advanced technology and the use of information brokers will so free users from the necessity of going to the library that they can manage to acquire necessary information at work sites or at home. Another issue will be the determination by each institution of the type of library service needed. Some libraries will lean more toward a self-service concept and limit professional activities to locating needed materials in other libraries. Others will build smaller working collections and provide more service in finding information. In either case, emphasis will be placed on reducing user cost and increasing labor productivity.

Supply/demand relationships can be controlled through either market pricing or nonmarket planning and by balancing immediate user needs with postponable needs. The trend toward fee-for-service will continue and expand so that libraries can increase their revenue base. Institutions of higher education will probably continue to fund basic library services from overhead, but special services are likely to be funded from user fees.

Interlibrary loan activity and the use of balance-of-trade accounts by members of library networks are trends which will accelerate. The rise of library networks is clearly linked to the technological innovation of machine-processible on-line bibliographic files coupled with electronic communications and the need for resource-sharing. In large measure, networks are an organizational vehicle for adopting a new technology appropriate to the provision of library service. As such, networks have become a means for spreading both social and technical innovations among libraries, thus serving as institutional change agents. From an economic perspective, library networks can be viewed as market-perfecting institutions. Thus, networks themselves are institutional innovations promoting more efficient linkages of supply and demand.

With respect to supply, networks provide the means for a redivision of labor and specialization of function among libraries and their suppliers and users. Currently this process operates through distribution of library activity among geographic levels (local, regional, national and international), and by subject interest lines (creation of special files and related services for highly specialized sets of clients which are geograph-
ically dispersed). This should lead to new patterns of interaction among libraries and publishers, with potential changes in the scope of library activity.

With respect to demand, networks provide a means for aggregating market demand. By concentrating diffuse demand, networks permit more specialization in the provision of information to smaller market segments. A higher percentage of customer satisfaction can be achieved by the resource-sharing facilitated and provided by networks.

In addition, networks provide a vehicle for resource-pooling to fund research and development effort. By having a more stable economic base for research and development, networks can promote innovations which are more efficient in the use of resources and more responsive to the needs of library consumers. This market-perfecting characteristic of networks is probably the single most significant feature of current innovation in library activity. The existence of multiple networks also can permit greater variation in innovation at modest cost, thus increasing the ability to learn from the innovative process by testing a variety of alternatives under field conditions.

CONCLUSIONS

Changing economic conditions and pressure for greater productivity from the public sector will be the major factors stimulating innovation in libraries. It is clear that institutions of higher education can no longer afford traditional libraries and comprehensive collections. Increasing wage rates and changes in consumer demand will force reallocations of library resources to provide funds for capital investment, more efficient operations and more responsive service. Library innovation will be an accelerating process.

The present level of understanding with regard to innovation is insufficient to provide clear guidance to library policy-makers. There is no general economic theory of innovation to provide the needed framework within which research and development efforts can be evaluated or innovation success predicted.

The likely future for most, and perhaps all, academic libraries will involve increased automation of a variety of labor-intensive processes and greater reliance on network-provided communications and resource-sharing facilities. The goals for libraries will be increased labor and user productivity and efficiency.

Academic libraries will be operating in an increasingly competitive
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environment. They will be competing, in some instances, with information brokers for business and with other academic activities for funds. The trend toward charging user fees will accelerate as libraries seek ways to increase their resources.

Finally, it is apparent that economics of library service need further study. Librarians will need to set aside outdated attitudes about library service, risk-taking, money and numbers, and rise to the need to innovate.

References


26. Ibid., p. 55.


29. Ibid.


33. Ibid., p. 19.


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