Organization and Management of the Information Center: Case Studies

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Abstract

This paper provides case studies of thirteen St. Louis based information centers. The objectives of the paper are to describe the responsibilities of information center professionals, to identify tools and resources for end user computing, to describe users and user-developed applications, and to identify policies relating to end user application development. The findings reflect the growth of information center resources and staff in response to rising demand for support of end user computing. Most user-developed applications were queries, reports, and analyses of production data extracts, as well as micro-computer based applications involving personal and departmental data. Informal policies and guidelines for user applications have been defined, but as yet most of these applications have not impacted the application development backlog.

Background for the Study

In his text, Application Development Without Programmers, James Martin argues that many of the problems of traditional systems development, including long development cycles, formal requirements specification, and formal maintenance procedures can be overcome by user-driven computing. In the environment Martin describes, users will work with systems analysts to create their own applications, using tools such as application generators to create prototypes.[1]

The organization of an information center, staffed with consultants who work with users, is a valuable approach to providing end user computing. In corporations with well-designed data bases, Martin suggests that 70 percent of user needs can be met with query languages and report generators. Less than 10 percent of the end-user demands for new applications require formal programming in languages such as COBOL. In addition, the maintenance problem can be alleviated.[2]

Information center operation will enable most firms to bypass the application development backlog. Report and application generators used will provide tremendous productivity increases, will eliminate the need to produce formal specifications, and will create applications that are relatively cheap and quick to maintain. Most important, the user will be able to work with the analyst to design systems which meet his needs.

Chet Mills, an expert in the management of end user computing, argues that the underlying objective of the information center is to enable operating level management to get the information they need to make more timely, better informed, accurate business decisions.[3] In particular, end user tools should reduce the time it takes to identify and to assimilate data, or to convert data into useful information for decision-making.

The organization of an information center can also benefit the information systems staff directly, Mills argues, by freeing I/S professionals from time-consuming maintenance tasks and enabling them to deal

with larger scale systems issues. In companies where information centers have been implemented for over 12 months, Mills reports, I/S management has reported a reduction in the ad hoc application backlog. That is, many of the requests for changes and modifications in reports can be handled by the users themselves. With the information center in place, I/S management is in a better position to develop true corporate data repositories which end users can use to fulfill their specific information needs.[4]

Since Martin's text was written, the growth of end-user computing within organizations has been overwhelming. The November 1983 issue of EDP Analyzer reports this growth at one of Xerox Corporation's major business components between 1970 and 1980.[5] In 1970, end user computing at this Xerox component was a very small amount of the 3.5 million instructions per second (MIPS) capacity. By 1980, end user computing had grown to almost 40 percent of the 70 MIPS capacity (an increase of 20 times over the decade) and was expected to increase to 75 percent of the total workload by 1990.

End-user computing, the EDP Analyzer report argued, in the not-distant future probably will overwhelm the information systems department. In other words, end users will demand services and support far in excess of what the I/S department can provide within budget--or even with a reasonable increase in the budget.[6] Some of the problems which will be likely to result from the rapid expansion of end user computing are the incompatibility of hardware, software, and data; lack of procedures for documentation and data security; and increasing demands for support.

The success of the information center will inevitably lie in its successful management. In the December 1983 EDP Analyzer article "Coping with End User Computing," several success factors are discussed. Providing users with access to corporate data, standardizing personal computers, offering training, and encouraging innovation are effective strategies. However, the report argues that a firm will be better able to cope with this new phenomenon if it identifies high-leverage uses for end user computing--uses that will help the company improve and protect its competitive position.[7]

The challenge that information systems management must face is how to manage the growth of user-driven computing so that the business benefits are maximized. Policies must assure continued organizational learning and at the same time establish adequate controls.

Objectives of the Study

The purpose of this study is to review the organization and management of end user computing which is supported by information centers. Case studies of thirteen information centers with at least two years of operation will be used. Specific objectives are:

1. To describe the role and responsibilities of information center professionals.

2. To identify the tools and resources used to support end user computing, as well as the rate of growth in demand for these resources.

3. To describe users and user-developed applications, and to determine if these applications have lessened the application and maintenance backlogs.

4. To identify policies relating to end-user application development, including standards, documentation guidelines, and audit procedures.

Related Literature

John Rockart and Lauren Flannery's study, "The Management of End User Computing," provides a thorough view of users, their needs, and their applications within seven major organizations. Six types of end users were identified, including nonprogramming end users, command-level end users, end-user programmers, functional support personnel, end-user computer support personnel, and data processing programmers. The largest percentage studies were functional support personnel, sophisticated programmers supporting end users within functional areas. Because of the diversity of end users, Rockart[8] argued that multiple software tools and differentiated training should be available to meet their needs.

Of the end user applications studied, 35 percent were report generation and inquiry/simple analysis, and 50 percent were complex analysis. Fifty-two percent of the systems were departmental in scope, and 31 percent were personal. Thirty-six percent of the data used for user-developed applications was extracted from production files. In the firms studied, most of these systems were developed by functional support personnel for non-programming end users.

Of the seven firms Rockart studied, only two had an information center. None of the firms had a strategic plan, control policies, or a means for assessing application development priorities for end user computing.

The question of whether information centers have enabled firms to reduce their application development backlog has been explored in several studies. In a report on end user computing in 71 medium to large corporations, plus two U.S. government agencies, 33 percent of the organizations reported a backlog reduction that at least came up to their expectations; 7 percent said that any reduction was less than expected; and 60 percent said that it was too soon to tell the effect of the backlog.[9]

A closely related question was whether the use of fourth generation tools in application development would reduce development time. In fact, 77 percent of the companies observed a reduction in development time, and about half of these firms reported that end users were using the tools directly.

In his study of end users as application developers, McLean identifies three types of computer applications: personal applications, which are designed to serve the needs of the individual; departmental applications which provide the reports, queries, and analyses for the department's information system; and corporate applications which involve data from several departments.[10] In his study of the impact of user-developed applications on the backlog, Robert Rosenberger argues that end user computing consists mainly of the ill-defined, "one-shot" types of personal and departmental applications which do not significantly impact the DP backlog. The backlog of larger, production systems projects is not necessarily lessened.[11]

Users, however, are in an excellent position to impact the maintenance problem, particularly those changes designed to extend or enhance the features of a system. If users are equipped with the tools to make simple queries, generate reports, and undertake analyses, most of this maintenance can be offloaded from DP professionals.[12]

In a study by Rivard and Huff, available literature was used to define the success of user-developed applications as resulting from a decrease in the DP application project backlog and a decrease in the DP maintenance load. However, interviews with DP professionals in ten organizations revealed that the primary aspects of success were user satisfaction with DP services, improved user productivity, decreased use of outside timesharing, and the assurance that the users were able to use computer resources in a manner profitable to the firm. The authors suggest that users themselves should be held responsible for evaluating the success and cost-effectiveness of their own applications.[13]

In a survey of end-user computing within 21 firms, Tor Guimaraes identified some of the issues raised by MIS attitudes toward end user computing. Of the firms studied, seven had personal computers for users but no information center, six had personal computers and no information centers, and eight had information centers but no personal computers for users.

One area of the study was policies affecting user-developed applications. Only two of the companies surveyed planned to establish quality assurance mechanisms for user applications even though most of the MIS executives interviewed expected user applications programmed in procedural languages to be technically deficient in comparison to systems developed by MIS personnel. However, most of the MIS executives had relatively little concern about user incompetence in developing applications.[14]

The main concern expressed by the MIS executives was the potential problem of mainframe data contamination. To guard against this, users were not able to upload data to production data files. However, they could download extracts of production data to do their queries and reports.

To overcome the problems of user-developed applications, Guimaraes argues that the internal audit function should be responsible for their quality and that MIS should establish systems development standards. Such standards would facilitate systems development, maintenance, sharing of systems, and training. Rockart, too, recommends that policies be designed to address the documentation, data security and data management requirements of user applications.[15]

Methodology

This study is based upon the experiences of thirteen St. Louis based firms who have organized information centers to support end user computing. The main reason for choosing these organizations was that each had an information center in operation at least two years. These organizations also participate in the St. Louis Information Center Exchange, SLICE, a group of information center analysts and managers which meets regularly to discuss issues and problems in managing end user computing. The information in this study was collected during interviews, company visits, and follow-up phone conversations.

Findings

The major findings will include the responsibilities of information center professionals, resources to support end user computing, the nature of user-developed applications, and policies relating to end-user application development.

Characteristics of the Firms

The following chart summarizes the length of time the information centers were in operation and the size of the information center staff within the MIS function. In all cases, the information center reported to the MIS area, and in all but one case, to the technical, operations, support, or data management group within MIS, as contrasted to the systems development group.

Company	Length of IC Operation (yr)	No. in IC Group	No. in MIS Overall
A	3	6	250
B	3 1/2	6	60
C	3	6	57
D	3	3	60
E	6	25	80
F	4	5	750
G	3	5	200
H	2 1/2	3	50
I	2 1/2	75*	3500
J	2 1/2	35**	4000
K	3	5	50
L	2	3	40***
M	3	4	150

* 75 analysts in three division level information center groups.
** 35 analysts in operating company user support centers.
*** Corporate staff MIS group

Major Responsibilities and Success Factors

The major responsibilities identified by information center managers in the eleven firms and the success factors for each firm are listed below:

Major Responsibilities and Services of the Information Center

	Number of Firms
Training	13
Consulting	13
Technical and operations support	11
Hotline	11
Management of data	10
Microcomputer software evaluation	10
Debugging assistance	9
Newsletter	8
Information clearinghouse	6
Prototyping	5
Developing data dictionary for user applications	3
Documentation support for user applications	3

Training. In eleven of the firms, training sessions were two- or three-day intensive workshops on how to use a particular tool such as FOCUS. In nine of the firms, computer-based training was used to educate users. Vendor sponsored training was used by eight of the firms. A summary of types of training provided through the information centers studied follows:

Type of Training	No. of Firms
Individualized instruction	13
Two- and three-day workshops	11
Computer-based training	9
Vendor Training	8
Other	2

Follow-up efforts on users who had completed training were limited, except for "hotline" calls during which users could talk about specific problems. Short courses were in great demand, and one firm reported that 12 classes with 25 to 30 potential users in each had been scheduled in the next six months to meet demand.

Requirements definition. In two of the firms surveyed, information center analysts in operating level divisions were actively involved in assessing user requirements, analyzing alternative design options, and evaluating whether the users' needs could best be supported by microcomputer based software, office automation facilities, or mainframe-based tools such as report generators. This was possible because these user support groups were responsible for training and support on microcomputers, office systems, as well as internal time-sharing services.

The three success factors identified by each of the information center managers reveal some interesting priorities:

Company	Success Factors
A	Acceptance by users Capacity planning Staff with communications and technical skills
B	User understanding of data processing Users' ability to do tasks independently User satisfaction
C	Managing data for users Effective training Helpful information center staff
D	Commitment of top management Effective marketing of IC to users Sufficient resources to support the IC
E	Responsiveness to user needs Ability to be information clearinghouse Reliability of service
F	Support of end user management Commitment of end users Ability of IC personnel to understand applications
G	Increased use by end users Increase in the number of users trained Reduction of requests for traditional systems
H	Staff willing to work with end users Ability to provide ongoing support to users including consulting and debugging help Effective in-house training
I	Top management support Competent, personable, knowledgeable staff Understanding of users' requirements
J	Top management support Wide variety of products available to users Market for IC services
K	Quick prototyping of user applications Quick delivery of information to users Good customer service

L	Acceptance by the user community Responsiveness of personnel to user needs
M	Timeliness of responses to user needs Support of top management

Some of the success factors frequently mentioned by the managers included top management support, quality of staff, and service to end users. The need to decrease the application backlog, to reduce the maintenance problem, or to minimize development time was not mentioned as a success factor.

Tools Supported by Information Centers:

The mainframe-based tools of the information centers studied were application and report generators, spreadsheet, statistical analysis, graphics, financial modeling, text processing, and electronic mail packages. The rate of expansion in mainframe-based resources in almost all cases was substantial.

	Companies			
Mainframe Tools:	A	B	C	D
Application or report generator	FOCUS SYSTEM W	EASYTRIEVE CULPRIT	FOCUS	EXPRESS MAGNUM
Spreadsheet	MEGACALC	OMNICALC		
Statistical analysis	SAS	SAS, SPSS	SAS	EXPRESS
Graphics	TELLEGRAPH	GDDM,PGF		EXPRESS
Financial modeling	MODEL	IFPS		EXPRESS
Expansion in capacity per year	160%	5%	None	5%

	Company			
Mainframe Tools:	E	F	G	H
Application or report generator	RAMIS	FOCUS MRCS	EASYTRIEVE ADRS	CA-EARL
Spreadsheet	EXECUCALC	ESS		OMNICALC
Statistical analysis	SAS	SAS		SPSS
Graphics	SASGRAPH	SASGRAPH	GDDM	
Financial modeling	IFPS			
Text processing	DCF	SCRIPT		
Electronic mail	PROFS	PROFS		
Expansion in capcity per year	45%	See *	100%	100%

*Moved from an IBM 4300 to a 3083.

	Company				
Mainframe Tools:	I	J	K	L	M
Application and report generator	RAMIS MARK IV FORESIGHT	NOMAD INQUIRY MRCS	FOCUS	ASIST	EASYWRITER
Spreadsheet			OMNICALC		
Statistical Analysis	SAS	SAS		SAS	SAS
Graphics	TELLEGRAPH	TELLEGRAPH	GDDM	GDDM	GDDM
Text Processing	SCRIPT	DCF		IFPS	
Electronic mail	ALL IN ONE (Dec)	PROFS	DISOSS		
Expansion in capacity per year	20%	150%	10%	---	Negligible

In addition to mainframe-based tools, microcomputer based software supporting word processing, spreadsheet, data base, and graphics applications was available to users in all of the firms studied. The most frequently mentioned software packages included the following:

Word processing	Displaywrite II, Volkswriter
Data base management	dBaseII, dBaseIII
Spreadsheet	Lotus 1-2-3
Graphics	Chartmaster, Lotus 1-2-3

The majority of the firms studied were attempting to standardize microcomputer hardware by creating lists of preferred vendors. A number of the firms were using the IBM Personal Computer or PC-compatible systems as the standard. In three of the thirteen firms studied, microcomputers and microcomputer applications were not supported through the information center; and in several of these firms, microcomputer acquisition was deliberately discouraged.

Users of the Information Center:

The users of the information center were categorized as mainframe or time-sharing users and microcomputer users, and as occasional and frequent users.

	Company				
Mainframe users:	A	B	C	D	E
Occasional	750	100	150	65	3000
Frequent	300	50	65	15	1000
Microcomputer users:					
Occasional	300	---	5	150	750
Frequent	200	---	1	300	500
Total managers and professionals:	5000	400	900	---	4500

	Company			
Mainframe users:	F	G	H	I
Occasional	1300	40	65	2450
Frequent	200	80	65	1050
Microcomputer users:				
Occasional	50	0	12	7200
Frequent	25	4	20	3080
Total managers and professionals:	8000	625	1500	20,000

	Company			
Mainframe users:	J	K	L	M
Occasional	1500	50	10	100
Frequent	1500	150	15	36
Microcomputer users:				
Occasional	4800	5	40	100
Frequent	2400	10	30	150
Total managers and professionals:	20,000	--	60*	2000

*corporate staff group

The percentage of managers and professionals using mainframe-based tools in the firms studied ranged from 8% to 37% with the average being 26%. The percentage of managers and professionals using microcomputer-based tools ranged from less than 1% to close to 50% for one firm. In five of the firms studied, the information center manager reported that fewer than 5% of the managers were microcomputer users. However, in two firms where incentives were being used to encourage microcomputer use, the managers estimated that there was currently one microcomputer to every four and six managers respectively. The percentage of managers and professionals using microcomputers was averaged for the firms studied, and this overall average was 16%.

User-Developed Applications:

The information center managers were asked to estimate the percentage of user developed applications in each of three categories: (1) query, data extraction, or report generation; (2) simple applications requiring logic or computations; and (3) sophisticated applications requiring complex analysis. The managers were also asked to estimate whether user-developed applications had displaced a percentage of the application development backlog.

User-developed Applications by Type

	Company						
Type:	A	B	C	D	E	F	G
Query	50%	95%	75%	40%	30%	50%	90%
Simple	30%	5%	15%	40%	30%	25%	9%
Sophisticated	20%	0%	10%	5%	20%	25%	1%
Displacement	None	15%	25%	0%	20%	5%	0%

	Company					
Type:	H	I	J	K	L	M
Query	50%	50%	10%	75%	50%	30%
Simple	50%	30%	70%	12 1/2%	30%	50%
Sophisticated	0%	20%	20%	12 1/2%	20%	20%
Displacement	5%	None	None	5%	None	None

The types of user-developed applications within the firms studied show that users are making queries and generating reports from existing data bases and designing applications requiring simple logic and some computations. When asked about displacement of the application backlog, most of the managers indicated that user-developed applications were not affecting the backlog because many users were designing systems which never would have become part of the backlog. In other words, users would not have asked the MIS group to develop personal and departmental applications in the first place. Without the availability of tools supported by the information center, most of these applications would not have been accomplished at all.

The information center managers were asked to describe the scope of user-developed applications by estimating the percentage of these applications which were personal, single-departmental, and multi departmental in nature. The overall percentages of applications in each of these categories, which is summarized below, shows that approximately two thirds of the applications are single departmental in scope.

Scope of User-developed Applications	%
Personal	27.0
Single departmental	66.5
Multi departmental	6.5

Personal applications accounted for about one-quarter of user-designed systems, and multi-departmental applications were only 6 1/2% of the total.

The sources of data used for user-developed applications included extracts of production data files and personal data. The overall percentage of user-developed applications using these data sources was reported by the information center managers as follows:

Sources of data for user-developed applications	%
Extracts from production data files	47.3
Personal data	31.4
Data from other end-user systems	13.6
Data from external data bases	5.2
Other	1.5

The primary sources of data were extracts from production data files and personal data. In the firms studied, users could obtain data extracts or copies of production data files, but could not obtain access

to "live" production data. They could download copies of data files to microcomputers and manipulate these data using spreadsheet and other local programs, but they could not upload their data into production files.

Because of policies governing data access, user-developed applications had a very limited impact on the application backlog. However, in a few cases, users were attempting to design systems on their own which were part of the new application development backlog. In one company,for example, a user group became impatient with the "waiting time" required to get a system developed by corporate DP and went ahead and designed the system using NOMAD, an application generator. Later, this same system was accepted by the DP group and became a production system. In two firms studied, user-developed systems on microcomputers had displaced the need for DP to develop these same systems on the mainframe.

Policies Regarding User-Developed Applications:

The next question to the information center managers was whether any policies or guidelines had been established governing the types of applications which could be developed by end users. In all of the firms studied, users could develop systems with personal and internal departmental data. In thirteen of the firms, users could use extracts of production data files to make queries and to generate reports. In one of the firms, users could obtain extracts of production data but mostly set up personal data files using FOCUS, an application generator, to query and generate reports. In four of the firms studied, most of the user-developed systems were microcomputer-based systems using departmental and personal data.

On the issue of policies affecting the types of systems which users could and could not develop, the companies reported that users could not design corporate critical systems and systems with data which would be used to update production data files. In one company in which managers were using extracts of production data bases to generate management reports, corporate DP issued a memo saying that these user-developed reports were not "blessed by corporate DP" and might not contain accurate information. Several companies had established informal guidelines specifying that users should not attempt to design systems involving data across departmental lines and large volumes of data records. One government agency said that any application requiring a data file with over 5000 records should be developed by DP.

Another area of interest was the types of policies and guidelines governing user-developed applications. The information center managers in the study were asked if guidelines governing documentation, backup and recovery, data security, types of applications, and data access and management had been established. The number of firms reporting each of the following types of guidelines is summarized as follows:

Guidelines	No. of firms
Guidelines on data access and management	9
Guidelines on types of applications	8
Data security procedures	8
Backup and recovery guidelines	7
Documentation guidelines	7

In almost all cases, guidance on documentation, data access, data security, and backup and recovery was provided to users during training sessions, but no standards were set. Users of microcomputer-based systems were wholly responsible for their data and operations, including testing and backup. Users of mainframe-based time-sharing facilities in most of the firms studied could rely on the MIS technical support group for backup of data files.

Most information center managers felt that their guidance on documentation requirements was not being followed. In one firm, users were asked to complete a report on each user-developed system, including information on the system name, owner of the data, controls, data base used, security, and backup procedures. The information center manager felt that completing the report might encourage the users to think about documentation needs. In several firms, specific documentation and data security guidelines were in the process of being established; and in several firms, auditing procedures for user-developed applications about were to be set.

The issue of documentation requirements was depicted well by one manager who said that many user-developed systems were being "lost" when the developer left the firm and was transferred to another area. As a result, many valuable departmental or personal applications had to be re-invented. However, another manager admitted that many user-developed applications were "one-shot" projects and that most users were hesitant to take the time to document them. Most of the information center managers felt that documentation would become an area of policy development within the next six months to a year.

Controls over End-User Computing:

The managers of the information centers studied were asked to identify the types of controls which had been established over user-developed applications, including audit procedures, management approval and cost benefit analysis. A summary of the number of firms reporting each of these types of controls follows:

Controls	No. of firms
Approved vendor list	9
Management approval	5
Cost-benefit analysis	4
Audit procedures	3

The major area in which controls had been established over end-user computing was in the area of hardware and software selection. In nine of the firms, a list of preferred vendors for hardware and software had been established. Users who selected hardware and software which was not "approved" by corporate MIS would not receive support, including training, consulting, or access to mainframe-based data files and facilities on the network, such as high-speed electronic printers. As a result, few users selected non-recommended equipment. One of the reasons for the preferred vendor list was the need to assure that microcomputer systems were compatible with the corporate data processing network.

In four firms, requests for microcomputers were reviewed by management. In another firm, a request for a personal computer had to be obtained from the division vice-president and then reviewed by a hardware planning board to assure its compatibility with the corporate network. Several firms reported controls over application development. in four firms, a cost-benefit analysis was conducted to justify a user-developed application requirement. In three firms, audit procedures for user applications had already been established.

One possible method of controlling end-user development is charging back for computer time and support services. A summary of services for which users were charged shows that in all but three of the firms studied, CPU time was charged back to the user.

Services (chargeback)	No. of firms
CPU time	10
Consulting	4
Technical support	3

However, only four of the firms also charged the user for consulting time in the range of $25 to $50 per hour. One firm absorbed use of time-sharing facilities as overhead in order to encourage use. As a result, use had risen 100% a year and an entire IBM 3083 was devoted to end user computing.

None of the firms studied had developed a method of setting priorities for end-user application development. Most of the managers believed that users and user managers themselves had to assess the benefits of their own applications and that they would pay for what was valuable to them. Most companies were planning to expand information center staff, facilities, and training programs to meet growing demand.

When asked to describe the three major issues with which they would be dealing in the upcoming year, information center managers cited a wide range of concerns. An issue which was mentioned by about half of the managers was support for the existing and projected user base. The need to provide increased tools, capacity, and resources, as well as to gain control of the existing workload were definite concerns.

A second issue, mentioned by four managers, was the need to integrate microcomputers and microcomputer support into the information center. Another issue was the need to establish guidelines for communications and networking, so that micro/mainframe links could be made and multi-vendor systems could be integrated.

The issue of guidelines for user-developed applications, including policies governing documentation and data security, was mentioned by four managers. During interviews a number of the managers suggested that procedures for auditing user-developed applications were to be designed. The development of effective training programs for end users was an issue identified by two of the managers.

A broader issue noted by several managers was the need to determine the mission and objectives of end user computing, to define the respective roles of the information center and data processing staffs in information systems development, and to encourage programmers and analysts to design applications using fourth generation languages and small business systems.

The range of issues highlighted by the information center managers reflected the tremendous demand for resources, the technical problems inherent in a rapidly changing environment, and the lack of clear guidelines for user-developed applications.

Conclusions and Recommendations

The findings of this study illustrate the growth of end-user computing in thirteen firms with information centers in operation over two years. Information center analysts within these organizations were primarily responsible for providing training, consulting, and support for end-user application development. In all cases, computer resources had been expanded rapidly to support the growing numbers of users.

Most user-developed applications were queries or reports from existing data bases as well as simple applications using these data. Although users were able to generate reports from extracts of production data files, they were unable to develop systems involving data across departmental lines or to upload data into production data files. Although most information centers had introduced users to documentation guidelines in training classes, it was felt that most users did not take the time to develop documentation. The only real controls over user-developed applications were in the form of standards for microcomputer acquisition, chargeback for CPU time and limitations on machine capacity.

In several firms, information center analysts were involved in defining requirements for user-developed applications, in analyzing alternative design options, and in assessing whether an application could be best supported by microcomputer-based software, a mainframe-based time-sharing facility (such as an application generator), or by an office automation system. In these firms, the information center was responsible for supporting not only mainframe-based tools but also office and microcomputer systems. In a number of firms, responsibility for office automation, microcomputers, and mainframe tools had not yet been organized under one umbrella.

Recommendations in the areas of training, technical support, application development, and controls can be made based upon some of the issues raised by the information center managers.

Much of the training provided by the information centers studied is in the form of intensive two- and three-day workshops with the only follow-up being hotline calls. Efforts should be made to develop advanced programs geared to the needs of experienced users and to organize user groups for the exchange of ideas and problems. Follow-up surveys may be an effective method of determining whether users feel equipped to develop their own reports and what kind of follow-up training and support is needed. In addition, users require direction in requirements analysis so that they can understand the tools which can best support their application.

In the areas of technical and operations support, the information center needs to take a proactive role and address the issues of data security and backup and recovery for user-developed applications. One method of assuring proper backup of microcomputer-based data files is to provide opportunities for users to upload data files to mainframe files for backup purposes. Many microcomputer users are spending a good deal of time in their own operations support and some of this support can be provided by corporate DP. Standards for data integrity and security should be transported into the user environment.

Another problem is "open shop" access to CPU time. Since most user applications run on-demand rather than being scheduled, some users are able to circumvent production schedules by running jobs with copies of data files. Policies need to address the "open shop" access issue.

End-user application development is a third issue. Although users were able to make queries, reports, and analyses, the prototyping of applications using fourth generation tools needs to be supported by the systems development groups within MIS departments. Requirements definition for user-developed applications needs to be established so that users can design the right systems with the right tools. Information center analysts should help the user determine if a particular application can best be supported by using a microcomputer, office system, or mainframe-based facility.

Requirements for documentation of user-developed applications should be established and include information on data files, logic, controls, and operational procedures. Applications which are transportable to other departments should be identified to prevent the tendency to re-invent the wheel.

Controls over hardware and software will be necessary to assure that microcomputers are compatible with the corporate data processing network, have access to host-based data files, and can share network resources such as high-speed electronic printers and hard disk storage devices. Control over application development will require user managers themselves to identify priorities for end user computing.

In conclusion, the evolution of the information center will follow a stage evolution. Chet Mills depicts five stages of information center growth. In the first stage he describes, users satisfy their individual data needs by making queries and generating reports. After initial success, simple applications requiring more complex logic are developed during a second phase. In a third phase, users recognize that multiple applications share the same data, and efforts are made to consolidate data, minimize redundancy, and improve data integrity.

In the fourth phase Mills describes, extended application processing, users begin to extend existing applications considerably and in some cases require very sophisticated application software. Now, the information center evolves into an application development center using more traditional systems development techniques and technologies. In the last and fifth phase, business systems planning for end user application development begins to occur, and information center analysts are moved into end user functional groups to work with users to develop information systems.

The phases which are defined by Mills on the basis of his experience with end user computing within many organiztions depict a stage evolution which not only involves the growth and support of technology but also organizational learning. To support this learning curve, information center analysts will need to continue to provide the training, support, and consulting which will be critical in moving ahead.

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