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ABSTRACT

This study focuses on the growth of the library automation market from 1981 to 1990. It draws on library automation data published annually in the Library Journal between 1981 and 1990. The data are used to examine: (1) the overall library system market trends based on the total and cumulative number of systems installed and revenue generated; (2) 10 individual vendors involved in selling automated library systems; and (3) the relationship between the new library system technology and the resulting implementation of this technology. The 10-year period can be viewed as the introductory phase of library systems. Growth in the number of systems sold and the amount of revenue generated increased through the period. By 1990, however, statistics showed that the number of systems sold increased dramatically, while revenues decreased, creating an environment for vendors to exit the market. The study of 10 individual vendors showed aggressive market competition. It was hypothesized that the introduction of new technology is reflected in an unusually large increase in system installations. The dramatic decrease in revenues in 1990 reflects the technology increase in personal computer computing power. The increase in library system sales can be related to the introduction of new technology to the automated library system market. Eight graphs displaying information about library market growth and revenues and vendor performance are appended. (Contains 27 references.) (KRN)

Library Research:
A Ten Year Analysis of the Library Automation Marketplace:
1981 - 1990

**A Master's Research Paper submitted to the
Kent State University School of Library Science
in partial fulfillment of the requirements
for the degree Master of Library Science**

by

Martha H. Fivecoat
April, 1992

A Ten Year Analysis of the Library Automation Marketplace:
1981 - 1990

Abstract

The early development of library automation began in the 1950s. The decades of the 1960s and 1970s saw the emergence of computer technology and the subsequent development of the national library services (bibliographic utilities) which centralized library automation. As the technology became available at a price that was affordable by individual libraries, the concept of local, decentralized library automation became popular. As the 1980s began, the use of a local library computer system for circulation control was about to become widespread. During the decade from 1981 to 1990, the library automation marketplace grew from a small number of systems and a few vendors to a very competitive marketplace. The library automation marketplace of the 1990s is characterized by dozens of vendors fiercely trying to develop systems that exploit new technology and to market these systems to a small number of libraries. Since 1982, the automated library marketplace previous years' sales and installations have been compiled and published annually by three library consultants in Library Journal. The library community has also annually noted this growth of automation in publications such as the ALA Yearbook. This study focused on the library automation market during this 10 year time period between 1981 - 1990. Ten-year totals for dollars of sales and number of systems installed were compiled using the ten annual Library Journal articles; the growth and development of the automated library system market as well as selected individual vendors are presented for this decade. The market analysis serves as a foundation for prediction of market trends in the 1990s.

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A Ten Year Analysis of the Library Automation Marketplace: 1981-1990

Introduction

The real beginnings of automation in libraries or the "mechanization of library procedures" began in the 1950s and 1960s; these early beginnings have been well documented (Boykin 1991). It is during the period between 1970 and 1990 that library automation became widespread. According to a 1983 report, "we are well into our third decade of library automation. The first decade, the 1960's, was dominated by primitive local systems," (DeGennaro 1983, 629). The 1970s were dominated by the introduction and development of large multi-type and multi-purpose library networks like OCLC and Dialog (Boykin 1991). The third decade, the 19`0s, was dominated by a return to local systems that have become multi-functional and sophisticated. These dominant trends in automation of the library during the past 30 years are a result of the cost and capabilities of the computer and related communications technologies that were emerging during the same timeframes. Today, somewhere and somehow, "a library is using the computer to assist in the performance of almost every function of a library" (Boykin 1991, 10).

Important products and services built on computers first became available to libraries as early as 1970 when the library service networks (i.e. OCLC) came into existence. Both the desire for shared cataloging resources and the economies of scale triggered a centralization of libraries for computer utilization (Rush 1988). However, there were two technological developments that occurred in the 1970s that affected the trend of library automation in the 1980s: 1) the emergence of the first affordable and powerful minicomputers and 2) the development of powerful telecommunications capabilities. As the 1970s came to a close, the online turnkey library circulation system was becoming available to libraries (Boykin 1991). A movement to local, decentralized library automation dominated the 1980s. This development and subsequent widespread use of the integrated local library system

during the decade of the 1980s is the focus of this paper.

The technological advances in computers and associated decreases in costs provided an opportunity for the development of a local library automation marketplace. The local library systems that evolved in the 1980s consist of computer software and hardware and include shared bibliographic files for circulation control, cataloging and later, an online public access catalog. In some cases, other functions were included as part of the integrated systems. By the late 1980s, acquisitions, authority control and serials control were also part of the integrated library system. These integrated systems were developed by both librarians and computer specialists.

A period of rapid growth in the buying of local library systems has occurred in the last 10 years. The capabilities of the systems have changed over this period; technology has improved and costs of hardware have decreased over the 10 years and the number of vendors has dramatically increased. Since the early 1980s when libraries could begin to afford the cost of local automation, an entire marketplace for the sale, implementation and maintenance of library systems has developed. These developments have been documented annually by the publication of a yearly library system marketplace analysis. But examining the growth of the industry over the entire 10 year period provides an opportunity for a high-level view or meta-analysis of the market growth patterns and trends which provides a foundation for prediction of growth patterns in this market in the future.

Literature Review

A great deal has been written about automated library systems. Beginning in the late 1970s, there were journal articles published about the early computer-based library systems marketplace (DeGennaro 1978). By that time, there were a growing number and variety of computer-based systems and services and librarians were advised to educate themselves about vendors, systems and technology so that when the time came to purchase, they would be prepared.

Annual Reports

By the early 1980s, the library automation marketplace had grown so much that it warranted a review in Library Journal. In February, 1982, Joseph R. Matthews, a library consultant, published the first of 5 annual articles reviewing the library marketplace (Matthews 1982). The article was 3 pages in length and carried the first "annual review" of library automation. While focusing on the automated circulation systems marketplace, Matthews summarized the data from a June, 1981 study which was written by his consulting firm (Matthews 1982). The data included number of total installed systems, number of new systems installed that year as well as a review of the viable vendors and an estimate of the total revenue of the marketplace. In the same year, the ALA Yearbook published an article reviewing the highlights of library automation for the year (Bierman 1982). The opening paragraph mentioned general economic decline and reduced funding for libraries, but continued to describe the accomplishments in library automation including system reviews of several (i.e. CLSI, DataPhase and GEAC) automated local library systems. Bierman (1982) focused more on new functionality rather than revenues although numbers of major sales were mentioned for some vendors.

By 1982, the perspective on library automation began to change. The annual article in Library Journal (Matthews 1983), was now titled the "automated library system marketplace" rather than "automated circulation system." The article had grown to 7 pages of coverage and 16 vendors (over the 11 in 1982) were mentioned. Again, the total systems installed and total revenue for the marketplace were determined. There was some discussion of "automation trends"; however, the

distance of the predictions for the future was only for one year ahead. The ALA Yearbook (Vol. 8 1983) contained several articles that discussed the automation aspect of the library. An article on circulation systems (Boss 1983) described major developments including the integration of other functions; another article on automation (Dowlin and Malyshev 1983) addressed the existence of vendor supplied turnkey systems providing names of large new installations and innovations during the past year.

Library Journal's third annual article (Matthews 1984) introduced and defined the word "turnkey system" and focused on the increased competition and changes that occurred during 1983 in the library automation marketplace. The article grew to 8 pages of system data which was illustrated with a variety of tables and an extensive list of names and addresses of system vendors. Matthews continued to focus on the years' trends and accomplishments including revenues, number of systems installed, cumulative number of systems installed and some system function information. During 1983, Matthews also published A Reader on Choosing an Automated Library System (Matthews 1983) which was a compilation of some previously published and commissioned articles that were relevant to the process of choosing an automated library system. The book provided one eye's view into the marketplace. The contributors were living the change of the marketplace but were not trying to predict its growth or widespread use.

Matthews again published his annual article (Matthews 1985) but appeared frustrated with the change in the marketplace. "Unrelenting Change" he titled that year's review of systems -- as if in the midst of such a technical explosion, the library marketplace would be status quo! The article grew to 10 pages and included 5 tables and two pages of vendors' names and addresses. The number of vendors grew almost as rapidly as the number of systems being installed. The growth was "considerable - 22%" in the previous year and it appeared to have overwhelmed Matthews. The ALA Yearbook included the topic of "Circulation Automation" under "Information Technology" and the article (Boss 1985) contained a picture of the computer facility of C.L. Systems, Inc. (CLSI). Some effort was made to describe "major developments" in the industry and to analyze the trends in the marketplace which were said to be integrated systems. In 1984, the book Integrated Online Library Systems: Principles,

Planning and Implementation was published by Genaway to help libraries understand the integrated online library systems and to plan for evaluation, selection and implementation. Genaway dedicated 37 pages to vendors and system descriptions. Some indication for price and number of installations for each vendor were included.

While both the ALA Yearbook (Boss 1986) and Library Journal (Matthews 1986) published gross revenues for the library automation market the figures differed by some 11.5 million dollars. However, both sources began to realize the enormity of the automated library marketplace and the slow down of the rapid period of growth that had occurred. Matthews cited a 9% growth in the year 1985 which was down from the 26% in 1984. This was the last of Matthews' articles which was 13 pages in length -- up from the 3 pages just five years before. There were at least 40 software and software/hardware vendors mentioned. Matthews' mention of the new trend among library automation vendors to trim proposals to the lowest possible price was the first (published) indication of the really tight competition present in the marketplace among library system vendors. Boss' article (1986) in the ALA Yearbook appeared to be the 1985 article with a few modifications, an indication that he, too, felt the growth in the market had slowed.

On April 1, 1987, the Library Journal again contained an annual review of the previous years' (1986) library automation marketplace. By that year, Joseph Matthews, who had written the previous 5 articles, became employed by one of the vendors (INLEX) and passed the responsibility of the yearly article to Robert A. Walton, another well known automation consultant. Walton claimed to be different in style and focus but to maintain the same spirit and same fair coverage for vendors. His style, however, decreased the coverage to 8 pages (down from 13) and limited the number of vendors to 32. Walton (1987) did address the description of market share for all vendors and reported the number of installations for that year and in total. He looked at the market niches -- by library type and by system -- which was the first for that perspective. Boss (1987) reworked his article in the ALA Yearbook and included 8 major trends, although he still focused on the emergence of the integrated library system as the primary trend. His total revenue figures, even if conservative, show continued growth, at some

level, in the marketplace.

Evidently, 1987 was a year for decreasing prices in library automation hardware. Some "experts" attribute the large increase in the number of installed library systems during the year to lower costs (Walton and Bridge 1988). Frank R. Bridge joined Robert A. Walton in co-authoring the annual review of the automated system marketplace. While they noted overall impressive growth (56 % increase over 1986), they mentioned the decreasing market shares of some of the original vendors. The article again covered 12 pages of the journal and listed 49 vendors as sources. The market was getting more mature and more competitive. And because of the competition, vendors were not as eager to publish revenue figures although the authors tried to project revenues based on numbers of installed systems. Boss (1988) reported total sales to be up; he suggested that only five major turnkey vendors realized modest gains during the year and that most of the others lost ground.

In 1989, Walton was again joined by Bridge in publishing the annual review of the 1988 automated system marketplace (Walton and Bridge 1989). The authors reported a flattening growth (16%) in the marketplace despite a continued trend for decreasing hardware costs making automated library systems more affordable for a greater number of libraries. The market niches were discussed which illustrated the trend of specific library automation vendors to "do better" in particular niches (i.e. primarily public libraries; or primarily academic libraries). In addition, the concept of the international market was introduced because several vendors were beginning to make considerable inroads into foreign sales. The 12 page article and review of 52 vendors indicate that the market was continuing to be healthy. In 1989, John Corbin published Directory of Automated Library Systems which contained an historical perspective on the development and evolution of systems as well as a complete directory of information about each viable vendor. The vendor data included, not only the number of systems installed and functionality available, but also information about staff, hardware, terminals, printers, etc. for each system -- a very complete view of the market. However, some of the information provided was from 1983 which was clearly out of date by 1989 when the directory was published.

In 1990, for the third year in a row, Walton and Bridge teamed to co-author Library Journal's

review of the library system marketplace. The report concluded that the growth in the market was flattening (Walton and Bridge 1990)– yes from 55% in 1987 to 16 % in 1988 and 9% in 1989. However, the article noted that by the nature of percents, as the overall marketplace grew larger, the annual percentage of increased installations flattened. This was the first hint at a larger picture of library automation than just examining one year's growth – an overall analysis of the marketplace for the three years from 1986 to 1989. The ALA Yearbook recorded library automation growth under "Information Technology". In this article Boss (1990) acknowledged expenditures in 1989 of $150 million and pointed out the trend to online patron-access catalogs (OPACs) that provide availability information as well as library holdings. He, like Walton and Bridge (1990), documented vendor revenues for the year with some discussion of about 12 vendors' library systems. He continued to report a stronger trend to decentralized automation over centralized automation with continued demands for improved information access. These trends are echoed in much of the other library literature. For example Library Hi-Tech published an article (Sugnet 1989) that contained analysis by five library system vendors of the future of library automation. These vendors discussed the library needs that could be met by automation as well as the libraries' demands for exploitation of improved technology.

The final article in that 10 year span of history was again published by Library Journal. A review of the 1990 Automated System Marketplace was written by Frank Bridge (1991). At this point, Robert Walton had left his consulting service to become president of one of the leading local library companies – CLSI. Bridge again analyzed the previous year in the library system market, and highlighted trends and noted problems that were beginning to occur. The topic was given 13 pages in the journal and the author listed the addresses of 44 vendors at the conclusion of the article. Bridge estimated the revenues from automated systems to be $178 million. The ALA Yearbook was not yet available for a comparison figure. A book published in 1991, Automation Services for Libraries. A Resource Handbook (Muro 1991) contained a current description of the viable players in the vendor side of the marketplace. The book devoted approximately 200 pages to the review of vendors and their library automation products and services. The number of vendors increased in a marketplace that was said to be limited

in size and to have fixed or decreasing financial resources.

Multi-Year Reports

In each of the previous 10 years, some annual review of the automated system marketplace had been published. Library Journal and typically, the ALA Yearbook dealt with the trends in technology, the growth in the number of sales and the total related revenues. However, there is yet to be published an analysis of the 10 year period from 1981 to 1990 that focuses on the decade of rapid development and growth of automated library systems. One article (DeGennaro 1983) did discuss a three decade perspective on library automation. He described the early beginnings of library automation with the development, first of large batch systems in the 1960s, the trend toward large online centralized systems in the 1970s and the beginning of the trend to local library automation in the 1980s. He forecast, incidently, that the library world would move toward decentralized networks which preserve maximum local autonomy and he was correct. DeGennaro (1983) had a vision; this study will focus on the facts that suggest that his vision became a reality.

In 1988, Rush (1988) published an article that addressed the library automation marketplace from the perspective of the viability of vendors. His article identified vendors by their governance and structure and he tried to explain some of the reasons that vendors were not able to maintain businesses in the library automation marketplace. While he examined some 150 vendors and their structure and governance, he did not directly deal with the 10 year period that forms the foundation of data for this study. A recent article, (Boykin 1991) dealt with a longitudinal study of library automation. He discussed the 20 year period from 1970 - 1990 but included the development of the bibliographic utilities, the CD-ROM revolution, local search options, the PC and the FAX machine, as well as the local online systems and the integrated library system as part of the evolution of technology as used in the library. He added information about the functionality of products during the 10 year period of focus but did not address the attributes of the library automation marketplace.

Summary

There has been a variety of literature published in the last 15 years that has examined the library

automation marketplace. The Library Journal and the ALA Yearbook have published an annual report of the developments of the products with some discussion of the market from a business perspective. Several long range articles have dealt with the technological explosion and the resulting changes in the library community. The library community has attempted to examine library automation from a variety of perspectives. To date, a ten year business growth analysis of the automated library system marketplace has not been published.

Research Objectives

During the period from 1981 to 1990 a number of libraries bought and installed local integrated, automated library systems. As the demand for these library systems increased, a marketplace for the sale and support of these systems developed. This study investigates this historic 10 year period of widespread implementation of local integrated library systems.

An integrated automated library system is defined as the computer software and hardware that operate together to provide shared bibliographic files that support library functions. Orlginally, library computer systems supported circulation control. As use evolved, cataloging and online public access functions were also supported. By the late 1980s, features to support acquisitions, authority control and serials control were also developed to share the bibliographic files of the system. Even though over the decade, the functions of a system expanded, the operational definition of an automated library system (for statistical purposes) is any system that shares bibliographic files and supports library functions.

The study will discuss library system vendors which are defined as companies whose business is the sales, installation and maintenance of automated library systems. In this analysis, no differentiation will be made as to financial or tax structure of the vendor. The objective of the study is to determine estimates of the number of vendors involved in the sales of library systems which, if all types of vendors are included, will be representative of the nature of the competitive market. The size and influence of the vendor will be determined by the number of systems installed, or market share.

This study examines the library system market from three perspectives. The first is an analysis of the overall growth trends over the ten year period; the second is the growth trends of 10 individual library system vendors; and the third is the influence of new technology on the fluctuations of the market. An analysis of these three aspects of the library automation market was compiled using the annually recorded statistics from the 10 Library Journal articles (Matthews 1982, 1983, 1984, 1985, 1986; Walton 1987, Walton and Bridge 1988, 1989, 1990; and Bridge 1991).

The first part of the research examines the sales and revenue of the total automated system marketplace in the 10 year period to determine the growth patterns and totals of the size (number of systems, total dollars of revenue) of the market during the 10 year period. The summation of systems installed and revenues generated provide the answers to these questions:

1) How many automated library systems were installed in the last 10 years?

2) What was the growth pattern in number of systems?

3) What was the total revenue from these sales in the 10 year period?

4) What was the growth pattern of the revenues?

5) How many vendors were involved in these sales?

6) How much money has been spent on library system maintenance in the past 10 years?

7) What was the largest increase (or decrease) in growth in the 10 year period (sales and dollars)?

8) What was the smallest increase (or decrease) in growth in the 10 year period?

The second part of this research is a case study of 10 library automation vendors over the 10 year period. These vendors have been selected from the many vendors that have been involved in the sale of library systems. The objective of studying the profile of 10 vendors' systems installed over the 10 year period is to provide some information about individual success or failure in the marketplace. The purpose of compiling data about individual vendors is to answer the following questions:

9) Which vendor had the highest number of sales in what year?

10) Which vendor had the largest total number of installed systems in which year?

The third focus of this research is concerned with the analysis of the library automation market trends to determine if there are any relationships to the development of new library system technologies

(i.e. OPAC). Advances in both hardware and software occurred during this ten year period. As noted in the literature review, the early systems just supported library circulation. During the 10 year period, the existence of an online public access catalog (OPAC) became prevalent. This study attempts to examine any growth in the overall market or in any individual vendors' growth by relating sales trends to the introduction of library system technology. The analysis attempts to answer the question:

> 11) Can periods of largest growth in system sales and revenues be related to the introduction of new technology (i.e. OPAC)?

To summarize, this research is concerned with three aspects of the library automation marketplace. The first is to examine overall automated library system market trends based on the total and cumulative number of systems installed and revenues generated in the 10 year period. The second objective of the research is to examine 10 individual vendors that have been involved in the sales and implementation of automated library systems over the same 10 year time period. The third part of the research searches for a relationship between the introduction of new library system technology and the resulting implementation of this technology in the sales figures derived from the overall market.

Methods and Results

Data Sources

Meta-analysis is defined as the analysis of multiple research reports. The purpose of this study is to develop a longitudinal market meta-analysis of the sales, installations and maintenance of computer-automated library systems in the ten year period from 1981 to 1990. The study is based on a series of reports published annually that collectively provide a high-level, long term study of the library system market activities over the ten year span. This research evaluates total market expansion and individual vendor developments, and their relationships to the changes in technology that occurred in the decade. Over the years from 1981 to 1990, significant library automation market data were published annually in the Library Journal. This set of 10 journal articles serves as the primary source of data for this longitudinal, meta-analysis.

The ten articles that were published by LJ are the work of three library consultants. Each article contains data that were collected from library automation system vendors in the market at the time of the survey. The data provide a consistent source for evaluation of the development of library automation. The articles are frequently cited by other publications such as the ALA Yearbook and are considered to be a significant source of library automation data. Each article contains quantities of systems installed or sold during the year, and related revenues that were generated by these sales. In addition, the articles contain information and commentary about leading vendors of the time.

The first five of these annual articles (1981-1985) were written by Joe Matthews, who established the structure for the data collection method by compiling responses from surveys that were sent to library system vendors. Matthews established the operational definitions of library system and library system vendor that are used throughout the set of articles. He also added his commentary about the "state of the library system market" and provided information (as available) about individual vendors. In 1986, the data were collected and published by Bob Walton, another library consultant. Walton maintained the definitions established by Matthews and increased the commentary about individual vendors. From 1987-1989, Walton and Frank Bridge continued to collect data via survey of the library

system vendors. In the final year of the decade, 1990, Bridge (alone) collected vendor data and published the market analysis. He, too, surveyed vendors, provided systems and sales revenues for the preceding year, and wrote commentary about leading and/or key vendors in the field.

All ten articles contain the number of automated library systems installed during the previous year. All of the articles except 1986, contain a figure for the total revenue that was generated by the sale of the installed systems. Each article enumerates the systems installed by individual library system vendor. Each article presents a total number of library systems installed for all years. All of the articles address a variety and range of other information about the installed library systems; the additional data was generally beyond the scope of this research but was used to substantiate interpretation when required.

Because these 10 articles contain significant market data that has been consistently collected and presented over the 10 year span, the use of the decade of Library Journal articles as the sole source of data for this study is justified. The public availability and consistency of this data make it appropriate for an initial market research investigation as does its publication in an important peer review journal in the library field.

The use of the 10 Library Journal articles establishes the operational definitions for the study. The definitions (for library system, library system vendor and revenues) that were used by Matthews, Walton and Bridge are accepted by this study, as well. An integrated automated library system is defined as the software and hardware that operate together to provide shared bibliographic files for circulation control, cataloging and an online public access catalog. In some cases, the definition is extended to include other functions such as acquisitions, authority control, and serials control, as they were developed as part of the integrated automated library system. The numbers reported in this study refer to library systems installed.

A library system vendor is defined as a company whose business is the sales, installation and maintenance of automated library systems. No differentiation will be made as to financial or tax structure of any company; the objective of the study is to estimate of the number of sources for an

automated library system which, if all types of vendors are included, will be representative of the nature of the competitive market. Revenue is defined as the money (in dollars) that passed from libraries to vendors as a result of the purchase of an automated library systems (hardware and/or software). Revenue figures are for systems installed.

Data Collection Procedures

The data collection process involved analyzing the set of market analysis articles for three types of information: overall library system market data, individual library system vendor data, and for indications of new technology in the marketplace. The first step in the process was to assemble the overall market data. From each article, the following information was extracted: Number of systems installed during the year for which the article reports; total number of systems installed by the end of the year for which the article reports; total gross sales revenue reported for that year; and number of vendors used as source data in the annual report.

The second step in the data collection process was to extract the chronological development of each of the 10 case study vendors. Qualitative facts about each of the 10 vendors were derived from the source articles creating mini-biographies of key suppliers in the library automation market. In addition to qualitative data, the following statistics were extracted for each of the 10 vendors: the number of systems installed during the year reported by the article, and the total number of systems installed to date by the vendor. The following vendors in the library automation market were used for the case studies: CLSI (CL Systems), Dynix, DataPhase, DRA (Data Research Associates), GEAC, NOTIS, Avatar-OCLC-Ameritech, VTLS, Innovative Interfaces, and INLEX.

The articles were further analyzed to uncover any changes in the market that may have been the result of the use of new technology. Market and vendor highlights were noted. In addition, the overall market figures (collected in step 1) and the narratives of the vendors (collected in step 2) were also used as indicators of significant change in automated library systems during this decade.

Data Exceptions

As with any meta-analysis of longitudinal data, minor variations of variable definitions and/or

data collection techniques exist. These problems must be accepted as an inherent problem in the methodology and do not prevent valid long term investigation and evaluation. There are several such data exception problems in this study.

The first data exception occurs between the 1985 and 1986 reports. The 1985 article was the last in the series by Joseph Matthews. In that article, Matthews increases the number of vendors reported to 40 from the 32 mentioned in the 1984 article. Many of the vendors that are listed in 1985 did not appear in any of the other nine articles. In 1986, Walton again reports from 32 vendors. This increase and subsequent decrease in the number of sources of data has an effect on the number of systems reported for 1985. There is also some discussion in both articles about systems sold compared to systems installed. The discussion and data suggest that some of the systems mentioned in the 1985 article were not necessarily installed. Because of the inconsistencies between the 1985 and 1986 articles, the number of systems installed for 1985 was adjusted to compensate for this anomaly. The 1985 article presents two figures: 235 systems installed and 107 software systems. The number 235 was used for this research instead of the sum, 342. The lower number more accurately represents the library system environment in 1985.

Another data exception occurs in the 1986 LJ article because it does not contain an overall total market revenue figure. The number of systems installed is presented; it can, therefore, be concluded that some revenue was generated and that some number (not zero) could be used for total revenue. For the purpose of this research only, an annual revenue figure for 1986 was derived from the data gathered from other years as follows: An average cost of system for 1986 was estimated by taking the median figure between the 1985 and 1987 figures. This figure ($560,000) was multiplied by the number of systems installed in 1986 to estimate the total annual revenue, $108,080,000. This revenue figure represents a reasonable estimate of the 1986 gross sales revenue for the library automation market.

The 1990 article also contained an anomaly in data collection that requires mentioning. In that year, Frank Bridge enlarged the operational definition of systems installed to include PC-based systems in addition to systems operating on larger computers. The published numbers indicate a large increase

in number of library systems installed. Until 1990, the automated library market had almost ignored library systems on PCs because such a library system (with one terminal) was considered trivial given the size, price and power of the other systems being installed. By 1990, the computing power of the PC and networking capabilities had increased enough to make the PC a significant type of library system in the market. The notable increase in systems installed in 1990 is a true figure for counting purposes, and for evaluation of the market; however, the reason for the dramatic increase should be noted as related to technology. Again, the anomaly should be considered inherent to the nature of a longitudinal study and the library system market and should not be an obstacle to meta-analysis of the growth of the library system market.

Data Presentation

Total Market Data. The data representing 10 years of growth of the automated library system marketplace is more significant when collected and presented as a decade of development than as 10 individual reports. The 10 separate years of system installations and related annual gross sales revenues are collected and presented in Table 1. When the decade began in 1981, there were (according to the reports) 226 library systems installed. During the 10 year period, the number of installed library systems increased 992% from 226 to 2695. In the first year, the annual revenue from system sales was $25 million. By the end of the 10 year reporting period, the gross revenue had increased to $178 million (a 612% increase). The gross revenues actually peaked in 1989 at $255 million which represents a 920% increase in that 9 year period from 1981 to 1989. The total systems installed was 2469 and the total revenue over the 10 years was $1,334,623,000. Figure 1 illustrates the growth and development of the library system market by number of systems installed and in millions of dollars of revenue over the decade.

A closer examination of the growth of both system installations and systems sales revenue provides additional information about the nature of the library system marketplace. The growth of system installations has been generally increasing over the decade. The number of installed systems (see Table 1) was a positive percentage in all years except 1986. The rate of growth increased until

1985, then decreased by 18%. Following a large (57%) increase in 1987, the growth increased positively but inconsistently in the next 3 years. There was a large increase (40%) of systems installed in 1990 which indicates a continued expansion of the market.

Table 1

Ten-Year Summary of Library Automation Systems Sales
1981-1990

Year	Yearly Systems	% Change	Total Systems	Yearly Revenue	% Change	No. Vendors	Average Cost/System	Est. (Accum) Maintenance
Pre-1981			226					
1981	75		301	$25,000,000		11	$333,000	$3,000,000
1982	81	8%	382	53,000,000	112%	16	654,000	9,360,000
1983	99	22%	481	70,500,000	33%	23	712,000	17,820,000
1984	167	69%	648	93,488,000	33%	32	560,000	29,039,000
1985	235	41%	883	104,087,000	11%	40	443,000	41,529,000
1986	193	-18%	1076	108,080,000*	4%	33	560,000*	54,499,000
1987	302	57%	1378	205,746,000	90%	50	681,000	79,188,000
1988	368	22%	1746	241,900,000	18%	52	657,000	108,216,000
1989	395	7%	2141	255,054,000	5%	39	646,000	138,823,000
1990	554	40%	2695	177,768,000	-30%	41	321,000	160,155,000
Totals	2469			$1,334,623,000			$518,000	$641,628,000

* The 1986 LJ did not report total revenue; an average system cost was estimated; total revenue was calculated from systems installed and average system cost.

The pattern of growth of the library system revenues does not necessarily mirror the growth of the system installed. For 1981, the annual revenue was $25 million. In 1989 the annual sales revenue peaked at $255 million which represents an increase of 920% in revenues. Until 1990, the system sales revenues showed positive increases each year. In 1990, revenue decreased by 30% to $178 million. The decrease in revenue but large increase in system sales is illustrated in Figure 1.

A comparison of the rates of change of the number of systems installed and amount of sales revenues over the 10 year period provides a foundation for interpretation of the development of the market. Figure 2 graphs the rates of change (in percents) of system installations and of system sales over the decade of the study. The two growth statistics were similarly decreasing from 1984 until 1986. From 1986 until 1989, the change in the number of systems installed paralleled the change in revenue. In 1990, the figures diverged with revenues showing a dramatic decline while number of systems installed showed a large gain.

How many vendors were involved in these sales? The numbers obtained from the journal articles (Table 1) are the counts of the vendors from whom the authors obtained market data and who were, reported to be key market players. In 1981, there were 11 vendors involved in the sale of 75 systems; in 1988, there were about 50 vendors involved in the sale of 368 systems. In this 7 year period, the number of vendors increased 5 fold. From 1988 to 1990, the number of vendors declined to 41 – a 20% decrease from 1988.

Once a vendor has sold and subsequently installed a library system, the relationship between vendor and library continues. Vendors are expected to support the hardware and software that was purchased by the library. For this support (or maintenance) service, vendors charge libraries an annual "maintenance fee." Library system maintenance revenue is defined as the gross revenue that libraries outlay to system vendors for continuing support and enhancements of installed library system products. A "rule of thumb" calculation of maintenance dollars is 12% of the library system purchase price (each year). For example, if a library purchases a system for $100,000, the maintenance fee charged by the

vendor is likely to be 12% of the purchase price, or $12,000 annually.

This maintenance revenue was not discussed in the 10 annual market analysis articles that were published by Library Journal. However, the maintenance fees that accompany the sales of library systems add significant revenue to the market particularly because of their cumulative nature. When a library installs a system, there is a one time sales price. In addition, this maintenance fee is paid annually for the life of the system. As illustrated in Table 1, the gross maintenance revenue accumulated over the 10 years of study becomes a significant part of the evaluation of the library system industry.

The maintenance for automated library systems was calculated to be 12% of new annual system sales, accumulating over the 10 year period. Using this method of calculation, a total of over $641 million has been paid by libraries to system vendors for maintenance of systems in the last decade. This figure may be conservative for several reasons: 1) No maintenance dollars were calculated for the 226 systems that were already installed when the 10 year period began, and 2) 12% may be a conservative estimate for maintenance fees. In 1990, the total revenue from system maintenance was $160 million which is 90% of the total systems sales revenue of $178 million for that year. Figure 3 shows the increasing percent of maintenance revenue to sales revenue over the decade. The sum of sales and maintenance revenue dollars provides an estimate for the total size of the library system marketplace. In this 10 year period, that figure is $1,976,271,000 or nearly $2 billion.

When were the largest and smallest years of growth of the library automation marketplace? According to the data, there was a decrease of 18% in number of systems installed between 1985 and 1986 which was the smallest growth year. All other years showed an increase in the number of systems installed with a 69% increase between 1983 and 1984 which was the largest increase in the decade. There was a decrease of 30% in revenue in 1990 over the 1989 market revenue which is the smallest year for revenue. However, there was a 112% increase in revenue for the industry in 1982 over the revenue for 1981. This represents a $25 million dollar increase which in dollars was matched or surpassed in many other years. However the percentage is an impressive increase in development. In

Figure 2 easily identifies the dramatic decreases in change in systems installed (1986) and change in revenue (1983). Equally visible are the largest increases: 1987 for both systems sales and related revenues.

An annual average library system cost was calculated from the annual systems installed and revenue and is reported in Table 1. The average cost of an automated library system over the 10 year period was $518,000. While sales and revenues fluctuated, this average system cost was less volatile. And the size of the average system purchase was indicative of the market environment. In general, over the decade, the purchase price of an automated library system was more than a half million dollars which describes a market of a few consumers making very large purchases.

In summary, in the past 10 years, there have been installations of 2469 library systems which generated revenue of about $1.3 billion. The library system market increased in size over the period and ended with a dramatic increase in the number of systems installed and as dramatic a decrease in the amount of revenue generated. The maintenance dollars associated with library system sales accumulate over the years and total about $642 million over the decade. The total dollars in the library system market in the decade were about $2 billion. The market is composed of 40 to 50 key library system vendors although the Library Journal articles suggest an oligopoly market with 10 or fewer of the vendors being really significant players.

Individual Vendors. The second part of this library system market analysis consists of 10 case studies of library system vendors. The 10 years of Library Journal articles were again used as the basis for compiling data about individual vendors in the library system marketplace. The vendors for case study, considered key players in the library system marketplace, are: CLSI (formerly CL Systems), Dynix, DataPhase, DRA (Data Research Associates), GEAC, NOTIS, Ameritech (Avatar, then OCLC), VTLS, Innovative Interfaces, and INLEX. These 10 vendors, as a group, own 78% of the market and represent the major vendors of the industry. Individually, none of them own more than a 17% marketshare.

To assess the extent of the business of these vendors, the annual statistics of each were collected from the 10 LJ articles. Table 2 contains the number of systems installed (No.) in each year,

and the total number of systems installed (Tot.) for each year for each of these 10 vendors. The yearly average number of systems (mean) installed and number of years of installs (count) have been calculated for each case study.

Analysis of the 10 years of statistics show that Dynix is the current leader among library system vendors. In 1990, Dynix installed 171 systems which was almost 1/3 (31%) of all new systems installed in that year. Including these installs, Dynix reported 478 total installed systems which is approximately 17% of all installed systems. Dynix has 143 more systems installed than the second place contender, CLSI. Various vendors have held the lead over the years but at the end of the decade, Dynix held a significant lead among the vendors of automated library systems.

The growth and development of individual vendors is a significant part of the total market analysis. Because the numbers of systems installed yearly and total systems installed do not adequately reveal the nature of the marketplace, some descriptive information about each of the vendors has been abstracted. These abstracts provide insight into the environment of the market and form a basis for examination of the market for introduction of new technology. The following individual case studies represent some evolutionary milestones for each of 10 vendors in the development and growth of a new marketplace.

Table 2

Library System Vendors
System Installations
1981-1990

Vendor	CLSI		Dynix		Dataphase		DRA		GEAC	
Year	No.	Tot.	No.	Tot.	No.	Tot.	No.	Tot.	No.	Tot.
1981	21	175			26	47	2	7	10	24
1982	19	180			13	59	2	10	17	41
1983	29	209	3	7	5	66	11	22	27	68
1984	19	228	15	22	2	68	10	32	25	93
1985	24	259	17	39	0	68	15	47	24	121
1986	32	277	27	64			15	60	17	136
1987	33	309	65	129			16	77	16	152
1988	22	331	77	206			24	101	8	154
1989	38	345	101	307			28	130	10	189
1990	16	335	171	478			44	174	45	222
Mean	25.3		59.5		9.2		16.7		19.9	
No. of Years	10	10	8	8	5	5	10	10	10	10

Vendor	NOTIS		AIS		VTLS		INLEX		Innovative	
Year	No.	Tot.	No.	Tot.	No.	Tot.	No.	Tot.	No.	Tot.
1981										
1982	6	6	3	3	11	18				
1983	4	10	3	6	16	34			8	8
1984	7	19	9	11	17	51			20	32
1985	21	39	19	37	9	58	2	6	16	48
1986	26	66	26	72	11	71	7	13	18	66
1987	25	91	22	140	14	86	16	26	20	86
1988	30	119	26	134	17	102	15	41	27	114
1989	13	132	3	134	16	118	20	59	40	155
1990	15	145	0	116	28	187	27	86	47	196
Mean	16.3		12.3		15.4		14.5		24.5	
No. of Years	9	9	9	9	9	9	6	6	8	8

CLSI. CLSI has been a leader in the library automation market over the entire decade. In 1981 when the decade of the study began, CLSI had already installed about 150 circulation systems which gave them as many installs as the rest of the vendors combined. Over the next 10 years as the market expanded, CLSI lost its head start advantage. In 1982, CLSI had 49% of the market. CLSI dropped to 23% in 1985, increased to 28% in 1986 by expanding into the foreign market, and then steadily declined ending in 1990 with a 12% marketshare. CLSI became an early leader by selling automated circulation systems. As the number of vendors increased and the install base increased, CLSI could not maintain their early lead. The declining growth of CLSI against the increasing growth of the automated library system market is illustrated in Figure 4. CLSI still holds second place among vendors but has felt the growth of the number and power of other vendors in the market.

Dynix. In 1983, some of the staff of Computer Translation Inc. (CTI), an early library systems venture, separated to form a new company, Dynix. Dynix acquired a few of the CTI library installations, but, for the most part, has grown from a start-up company in 1983 to the leading vendor in the library systems market in 1990. Based in Utah, the company originally had a relationship with Eyring Research Institute but broke away from them in 1986. In 1987, LJ called Dynix the "Flagship Vendor" of the year because it increased marketshare from 3% to 6%. Dynix' successes in increased sales can be attributed to the fact that Dynix targeted the smaller libraries and was able to make sales and install systems successfully in the low-end of the market. Exploiting the development of a specialized market niche, this target for small systems continued through 1990 as Dynix moved to be the leading vendor with 17.4% of the worldwide market share. Figure 5 illustrates the dynamic growth of Dynix in the marketplace.

GEAC. Over the decade, GEAC has persistently been one of the leading vendors in the market. The survival of GEAC clearly illustrates the environment of the library system marketplace. In 1981, GEAC was a third place leader with 24 library system installations. By 1984, GEAC had moved ahead of CLSI in new system installations for that year. By 1986, it was widely publicized that GEAC had corporate financial problems and they made fewer installations in 1986 than in 1985. The next year,

1987 saw GEAC suffer large loses; however, GEAC announced that it would again become financially sound. In 1988, the company returned to profitability and the 1988 LJ article stated that GEAC and CLSI remained the tenured, historical leaders. In 1989, GEAC introduced a PICK operating system based product that positioned them for their increased sales in 1990. Despite GEAC's struggles to remain financially stable, they were again in third place behind CLSI and Dynix in market shares.

DRA. By 1981, Data Research Associates (DRA) had installed 5 systems in libraries for the blind. By 1983, their market had branched to regular academic and public libraries. DRA continued to grow steadily over the next 8 years of the study, particularly in the academic library market where 75% of their installations were made in 1987. DRA tended to install in smaller academic libraries over the years 1988 - 1990. Since 1985, DRA has been a leader for an adherence to standard code of ethics for hardware, software and data formats among library vendors. The DRA call for compatibility among vendors tends to generates lots of interest but not compliance among the vendors of this naturally competitive market.

NOTIS. The NOrthwestern Total Integrated System (NOTIS) was originally developed at Northwestern University in the late 1970s. By 1982, 5 other libraries had worked with Northwestern staff to install the system. In 1983, Northwestern began an aggressively campaign to market the NOTIS library system and installed it at another 4 more libraries. NOTIS tended to be popular with other large academic libraries and over the years 1984 - 1986, NOTIS become a significant leader in the large academic automated system marketplace. In 1987, NOTIS, dubbed "king of the large systems," incorporated as a wholly owned subsidiary of Northwestern. The technical focus was on improvement to public access components of the system and in 1989, NOTIS announced the MDAS product for access to other bibliographic databases (in addition to the local catalog). NOTIS continued to be the choice of ARL (Association of Research Libraries) libraries in the academic community through the decade. It is important to note that while the number of NOTIS' installed systems is well below some of the other vendors, NOTIS' market niche has been the larger libraries.

VTLS. VTLS also originated at an academic library, Virginia Tech. The system was designed

on Hewlett Packard computer equipment and was installed at 18 libraries by 1982. Soon after that the library realized that being a systems vendor placed unusual demands on the library staff and in 1984, Virginia Tech and Hewlett Packard began a joint marketing venture for the system. In July of 1985, VTLS became a for-profit corporation and by 1986 had an 8% share of the market. VTLS experienced moderate growth in installations (11 in 1986) but experienced rapid growth (75%) in staff and sales revenues (100%). In 1988 and 1989, VTLS expanded to the European market which resulted in a 6% market share for the company. In 1990, VTLS was marketing a PC-based software package which accounted for not quite half of their installs in that year. VTLS was expanding to the low-end of the market.

INLEX. INLEX was a relatively newcomer to the library system marketplace, not appearing on any of the statistics until 1985 when the reports credited the company with 2 new installs and 6 systems installed. INLEX originally showed strength for both public and academic libraries and was one of the early vendors to break into the public school library market in 1987. The INLEX growth was very steady through 1986 - 1988; in 1989 the company had its best year with a 30% increase in installations. By 1990, INLEX owned a 3% of the total market share. INLEX is an example of a late entry into the market that continues to battle for a share of the market each year.

Innovative Interfaces. Innovative, like INLEX, was a latecomer to the market. Innovative began by providing a "black box" interface between CLSI and OCLC and subsequently developed serials and acquisitions (standalone) modules. In 1986, Innovative had 66 installations but there is some question as to whether these InnovACQ (acquisitions and serials control) installations can really be counted as integrated library systems. By early 1987, Innovative released a circulation control system and established themselves fully as a vendor of integrated systems. Since then, Innovative has grown into a significant player in the library automation marketplace. They sold 27 systems in 1988 and successfully migrated from proprietary hardware to the DEC VAX hardware environment. In 1989, Innovative was tied with CLSI as the leading vendor of the year with 39 system installations. And then in 1990, Innovative clearly distinguished itself from the other vendors with 43 installations and $20

million in revenue. The addition of circulation and public access and the migration away from proprietary hardware aided Innovative in its successful growth in the three years between 1987 and 1990.

Ameritech Information Systems. Early in the 1980's, the National Library of Medicine developed an automated library system and several vendors evolved from the development of this system. Avatar Systems and Online Computer Systems both began marketing the NLM integrated library system. In 1982, the LJ article shows Avatar with 3 systems and Online Computer with 3 systems installed. That article also discussed OCLC's intentions to market a system developed by Claremont Colleges. In 1983, OCLC bought Avatar and also the installations of Online Computer Systems, renaming the product LS/2000. In 1984, OCLC installed 9 more systems and again in 1985 showed a large increase in systems installed (19). By 1986, OCLC owned 8% of the market and was battling for 3rd place among vendors. In 1986, OCLC had 30 system acceptances and also acquired the ALIS I and ALIS II systems from DataPhase. Called the "Fast Track" vendor for 1987, OCLC signed 46 of the DataPhase sites and by 1988 brought their market share to 8%. However, in 1989 OCLC retreated from the market making only 3 installs. And in 1990, OCLC sold its integrated library system division to Ameritech Information Systems and virtually left the local library system marketplace.

OCLC's retreat from the marketplace is an example of the behavior of other vendors that have been less successful in selling and maintaining integrated library systems. At the low end of the vendor case studies is DataPhase, a company who was an early leader in library system sales and installations and who vanished from the market by 1987.

DataPhase. DataPhase is a vendor that has "come and gone" from the marketplace. By the first article in 1981, Dataphase installed 26 new systems and had 47 total systems installed. Despite the fact that their management changed, 1982 saw 13 systems installed. Another management change in 1983 still did not prevent the downtrend for the company. In 1984, the company only had 2 installs and in 1985 there were none. By 1986, the company virtually disappeared by selling its Tandem based software to UTLAS, another library vendor (from Toronto, Canada) and the ALIS II installations and

software to OCLC. DataPhase installed one-third of the new systems in 1981 and was not in business by 1986 which illustrates the environment for easy exit from the market.

The brief narratives of these 10 vendors provides a characterization of the activities in the market over the 10 year period. All of the companies described were small businesses involved in a new venture – the automation of library functions and processes. In addition to these 10 vendors, there were many others also selling library systems. For instance, in 1987 and 1988, there were more than 50 vendors involved in library sales. The changes in upper management, the buyouts of vendors in the market (or exit depending on perspective), and the introduction of new functions and technology to the systems in an effort to meet the needs of libraries are all examples of the aggressive business practices used by vendors over the decade.

Technology in the Market. The third part of this research was an effort to identify the use of new technology in the market by analysis of the growth patterns of the total market and of individual vendors. Examination of the growth charts indicate that the 1986 systems installed decreased by 18% from the systems installed in 1985; however, there was a large increase (57%) between 1986 and 1987 (193 to 302 systems installed) which creates a highlight for review of the market. During that year, CLSI announced a move to a UNIX platform; Dynix broke from its parent company; OCLC had a dramatic increase in systems installed; Innovative released its InnoPAC system; DRA added Boolean searching to its OPAC; and NOTIS introduced keyword and Boolean searching. The average price of a system increased from $560,000 to $681,000 in 1987. At the same time, GEAC was suffering financial difficulties and DataPhase left the market.

Can the changes between 1986 and 1987 be attributable to new technology in the industry? It appears that the big increase in sales in library systems in 1987 was related to the introduction of online public access (OPAC) capabilities in library systems. The OCLC system, LS/2000, had one of the better OPACs of the time. NOTIS and DRA were adding Boolean searching capabilities to the OPACs of their systems and Innovative released the public access parts for the InnoPAC system. And DataPhase left the market; the system they sold to OCLC, ALIS II, was primarily a circulation system with

little public access capabilities. The increase in system sales in 1987 may be attributable to improved system software technology that provides online public access capabilities to the library systems available in the market.

The second significant time period for growth was 1989-1990 when the number of systems installed increased a dramatic 40%. At this time, CLSI was cooperating with Innovative Interfaces in marketing their products, Dynix was expanding by selling to smaller libraries, NOTIS was focusing on smaller libraries with a turnkey (KeyNOTIS) system, and DRA, GEAC, and INLEX were improving communications with other systems and access to other databases. The trend, if any, among the vendors was to expand their sales to smaller libraries and to connect to other systems. In 1990, the LJ article noted that the number of installed systems included PC-based integrated library systems in addition to the larger systems. The trend seems to have been expansion of the market to smaller libraries and vendors were selling PC-based integrated systems.

This is a more concrete example of the introduction of new technology: the PC, first available in the late 1970s, had increased in computing potential so dramatically that by 1990, it was capable of providing the power required to support an integrated library system. The increase in computer hardware technology made the PC capable of performing in the library market. The use of the new, faster hardware chips caused an expansion of the library system market. This use is illustrated in the increased number of sales in 1990, the redefinition of the operation variable to include PC systems and the decrease in average system cost.

Discussion of Results

Interpretation and Implications

Total Market. The results of the 10 year accumulation of statistics of the automated library system market reveal a number of market characteristics that are otherwise undetected. The collected data provides an opportunity to evaluate and interpret rates and characteristics of change through the decade and to predict future development of the automated library system industry.

The ten year period from 1981 to 1990 can be viewed as the introduction phase of library systems. Growth in the number of systems sold and the amount of revenue generated were generally increasing through the period. The 2469 systems installed that generated over $1.3 billion represent the size of the market and results of the rapid growth period. However, the last year, 1990, indicates a milestone in the market development. The number of systems sold reflect dramatic growth while the total amount of revenue showed a large decrease. This divergence is important to the library community because it represents an environment for a decrease in the number of library system vendors. The sale of smaller, less costly systems means generation of less total revenue. When the total revenue in the market decreases, there are fewer dollars to spread among vendors; as a result, vendors will be forced, for financial reasons, to exit the market. From 1988 to 1990, the number of vendors declined from 52 to 41 – a 20% decrease. The trend for vendors to exit the market has begun.

As discussed, the maintenance dollars continue over the life of the system and have impact beyond the initial sale of the library system. As time passes and the market size increases, maintenance revenue has an increasing impact on the economy of the market. Vendors can survive for some time on the maintenance revenue generated from past sales, so that if new sales decrease, there is a time lag for survival. Figure 3 depicts the increasing percent of maintenance revenues to sales revenues over the 10 year period. In the first year, maintenance dollars represented only 12% of sales revenues (by definition); in 1990, the maintenance revenue represents 90% of new sales dollars. Despite the fact that sales revenues decrease, the total sales and maintenance revenues increased as a result of the number

of new installs and the continuing maintenance fees for both new and old sales. The significance of first getting a customer, and secondly, keeping a customer becomes more important when interpreted in light of the significance of system maintenance revenue.

It is important to note that the average library system purchase price is decreasing. As the market definition expanded to include systems at the low-end of the price scale, the average system price decreased by more than half. As the purchase price decreases the quantity of systems demanded increases causing an expansion in the market. The decrease in 1990 is a significant indicator of changes occurring in the marketplace. This average system cost peaked in 1983 at an estimated $712,000. The average system cost in 1990 has dropped to $321,000 which has several explanations. The addition of low-end PC-based systems in the statistics bring the average down; however, at the same time, hardware prices continue to drop with higher speed technology costing less. This drop in the cost of a system implies that there should be additional libraries that can afford to automate. With costs dropping, an automated library system should be within financial reach of more libraries and the market size will again grow in the number of library systems in the market.

The size of the increase in demand for library systems can be calculated by using the concept of price elasticity of demand. By the nature of the demand curve, when the price of a system decreases, corresponding quantity demanded increases. The rate of change is related to the shape of the demand curve for the product. By calculating the price elasticity of demand for the change from 1989 - 1990, an estimate of the increase in sales can be predicted for 1991, if the slope of the demand curve remains constant. Between 1989 to 1990, the average price of a library system decreased from $646,000 to $321,000 (50%), and the number of systems purchased increased from 395 to 554 (40%). The following calculations provide the price elasticity of demand between 1989 and 1990 for automated library systems. This calculation establishes a ratio by which the next years' sales can be predicted. In the following equation, Q = the number of library systems demanded; P = the price of each system; 1989 is Year 1; 1990 is Year 2.

Price Elasticity of Demand

$$\eta = \frac{\Delta Q_D}{(Q_{D1}+Q_{D2})/2} \div \frac{\Delta P}{(P_1+P_2)/2}$$

For Automated Library Systems 1989 - 1990

$$\eta = \frac{159}{474} \div \frac{325}{483}$$

$$\eta = .498$$

The price elasticity of demand for automated library systems between 1989 and 1990 is .498. Because the price elasticity of demand for automated library systems is less than 1, the elasticity of demand is said to be inelastic. An inelastic price means that a further reduction in price will (again) reduce the total expenditures in the market on the product which implies that even if demand, or quantity of systems sold increases, the total sales revenue will again decrease.

Using the price elasticity of demand of .498 for 1990 and predicting 1991, there would be sales of 776 automated library systems, assuming a constant demand curve. The average system price will be approximately $160,000 and the total market system sales revenue is predicted to be 123.3 million. The elasticity of demand is one model that can be used to predict future market trends.

As system costs decrease, the related maintenance revenues will also decrease and there will begin to be fewer dollars in the market despite the fact that the number of libraries with automated systems will increase. With decreasing system costs, libraries are likely to see fewer "services" packaged with the sale of the system. Vendor supplied training, support and other consulting services may be provided at additional cost in order to recover the decreased costs in systems. Vendors whose costs are too high will not be able to maintain a profit, or even break even, as prices decrease. Again,

watch for changes among vendors in the market. Decreasing prices with inelasticity of demand implies decreasing revenues which will force some of the inefficient vendors out of the market.

The important facts to note about the total automated system marketplace are the generally increasing size of the market (both systems and revenue) but decreasing unit purchase price of the systems. The market is positioned to show another increase in systems installed, a decrease in revenues and another decrease in average system price. The continuing system maintenance dollars increase the total monetary size of the market and are becoming more significant over time.

Individual Vendors. The 10 year study of vendors provides an opportunity to visualize the aggressive competition in the market. Figure 6 illustrates 10 years of contention between the three leading vendors of the library systems market. CLSI was the dominant vendor from 1981 until 1989. At that point, Dynix, who was not even on the chart in the early years, became a major player and in 1990, was the clear leader in the industry. GEAC's presence in the market has been constant despite financial difficulties through the middle years. Dynix' aggressive growth and takeover as leader in the market must be noted.

In addition to the contest among the leading vendors, there is a similar intense battle among the middle vendors. Figure 7 plots the number of yearly installations for the next six vendors (VTLS, Innovative, DRA, INLEX, NOTIS and Ameritech) and the graph provides an overview of the relative development of these vendors. Figure 8 plots the total number of systems for each of the above six vendors and, again, the contest for market share is obvious. It appears that by 1990, there was enough distinction in systems to cause some divergence in yearly systems sales. But overall, these six vendors are very close in competition and in market share as illustrated for total systems installed in 1990.

All nine of these vendors seem to hold enough market share to continue to exist in the market. If the number of systems continues to increase as the market expands into the smaller libraries, and the cost of each system continues to decline, will the keen competition continue or will the vendors of small systems overtake the vendors of the few large systems? How many more libraries are positioned to automate in which sectors of the market? The research has generated many questions; can it be used

to accurately predict the future development of the market?

Technology in the Market. The answer to that question may be determined by understanding and interpreting the reaction of the market to the introduction of new technology. This meta-analysis of the automated library system market has detected two peaks in systems installations. In both cases, arguments can be presented that directly relate the introduction of technology into the market to the dramatic increase in system sales.

The 1987 increase in system installations was related to a time of development and enrichment of software functionality. In 1987, vendors were announcing additional functions in the online public access modules of the systems. Several vendors were improving OPAC functions by adding Boolean and/or keyword searching. One vendor introduced the capability of accessing other databases in addition to the public catalog through the same user interface. A valid argument can be developed that shows that the introduction of new software technologies (information retrieval) created an environment for an increase in sales in the automated library system market. In 1987, the technology was additional software functions which increase vendor costs; as a result, system price remained high and the vendors' revenues increased as well.

The 1990 figures reveal another growth spurt in system installations. Because the operational definition of system enlarged, the growth can be directly attributable to new hardware technology in the market. The faster computer hardware chips became available to the entire computer community but had an unusually large effect on library systems because small computers were suddenly powerful enough to support the work of a library. However, this new technology was less costly and as a result, average system cost decreased. The related sales revenues decreased causing the size of the market (in dollars) to also decrease.

It appears that large increases in systems installed can be linked to the introduction of new technology in the market. However, revenue operates independently depending on the type of technology change. In the two examples, when software improved, the revenues increased; when t

technology caused a decrease in price, revenues decreased as well. An increase in the number of systems installed in any year may be linked to the introduction of a new technology. The absolute value of the change in revenue signifies a changing market environment. A dramatic negative change can signal new technology as well as a dramatic positive change.

Conclusions and Summary

Conclusion

In 1981, the library automation marketplace was in its infancy. By the end of that year, there were about 300 libraries with automated systems and the market generated about $25 million in revenue. The following decade saw a widespread, rapid growth of the implementation of library systems. By 1990, nearly 3000 libraries had installed library systems and the industry revenue over the period equalled $2 billion. The library community had monitored this development through annual publications about the growth in Library Journal and other sources of market data. The milestone of 10 years of annual data begged for a summary and analysis of the decade.

This study quantified the 10 year growth period in system installations and in market revenue for both sales and maintenance of library systems. All years (except one each for system installs and sales revenue) exemplified positive increments in growth with some variance in the rate of growth from year to year. There were two years, 1987 and 1990, that reported excessive rates of growth in the number of systems installed. In 1987, it appears that added system functionality in the area of public access provided a technical change that increased installations. In 1990, the enlargement of the market to include PC-based library systems indicated the technical revolutions at the low end of the computer scale.

Despite continuing increases in the number of systems installed each year, the total revenue from sales declined dramatically in the last year. The decline in revenues was related to the decline in average system cost which illustrates the trend in the computer industry toward increasing power and decreasing costs for hardware. The decreasing revenue is an indicator for a succeeding market change because if revenues are smaller, the market cannot support as many vendors and therefore, either some small vendors will fail or some large vendors will takeover smaller ones.

Among individual vendors, there are three leaders in the industry. CLSI and GEAC were positioned at the beginning of the decade and they remain historical leaders in the market. Since 1984,

Dynix has developed from a new company to the clear market leader in 1990. Dynix currently holds 17% of the market alone; the three vendors together own 40% of the market. Behind these three, there are (at least) 6 vendors that are in close competition in the "middle of the pack." These next six vendors own the next 35% of the market. Some of these vendors have narrowly defined their system to a specific market niche to increase their market share.

Vendors who cannot maintain pace with technology development or whose costs are too high cannot exist in the competitive market. The story of DataPhase is not the only story of a vendor that appeared and then disappeared from the library system marketplace. OCLC, a long time leader as a bibliographic utility, was in and out of the automated library system market in less than 7 years. The market is not stable and the entry and exit of vendors is prevalent.

It was hypothesized that the introduction of new technology to the library system market is reflected in an unusually large increase in system installations. The large increase in sales in 1987 was related to the introduction of OPAC technology in the software. The dramatic decrease in revenues in 1990 reflects the technology increase in PC computing power which became available to the library community. The increase in library system sales can be related to the introduction of technology to the automated library system market.

Summary

This report provides a foundation for further library system market research. In this study, the data sources were restricted to the articles from Library Journal that have been published over the 10 year period. This data contains some anomalies but does provide a consistent base for a 10 year longitudinal meta-analysis study. The summary of the LJ data can be used as the starting point for future research. Additional data sources can be used to substantiate or verify the accuracy of the data presented here. In addition, the vendors could be surveyed again to try to substantiate the figures that were presented in Library Journal.

An historical research paper could be developed to account for the large increase in the library automation market in 1987. A literature review to determine the state of technology just prior to that

increase could provide more information for the analysis of the market change at that time. If the individual library system evolutions were better documented, then the 1987 change could be explained and better market change indicators could be authenticated. An in-depth study of the vendors may provide more information about the trends in the total market patterns.

And finally, if Library Journal continues to publish an annual survey of the library automation market, the yearly figures may be added to these statistics to elongate the study. The study could remain a 10 year study by continuing to take just the preceding past 10 years, replacing the 1981 data with 1991 data, and so on. Or the number of years of the study can be increased to provide a longer historical platform from which trends in the future of the automated library system marketplace may be predicted.

APPENDIX A

PRIMARY RESOURCES

Ten Years of Annual Reviews of the Library Automation Marketplace:

Bridge, Frank R. (1991). Automated system marketplace 1991: Redefining system frontiers. Library Journal. April 1, 1991, p. 50 - 62.

Matthews, Joseph R. (1982) The automated circulation system marketplace: Active and heating up. Library Journal. Feb. 1, 1982, p. 233 - 235.

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Walton, Robert A. (1987). The 1986 automated system marketplace: New perspectives, new vistas. Library Journal. April 1, 1987, p. 36 - 43.

Walton, Robert A. and Frank R. Bridge. (1988). Automated system marketplace 1987: Maturity and competition. Library Journal. April 1, 1988, p. 33 - 44.

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Boss, Richard. (1983). Information technology. The ALA Yearbook: A review of library events 1982. Chicago: American Library Association, Vol. 8.

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Dowlin, Kenneth E. and Nina Malyshev. (1983). Automation. The ALA Yearbook: A review of library events 1982. Chicago: American Library Association, Vol. 8.

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Matthews, Joseph R. (1983). A Reader on Choosing an Automated Library System. Chicago: American Library Association.

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Rush, James E. (1988). The Library automation market: Why do vendors fail? A History of vendors and their characteristics. Library Hi Tech 6(3): p. 7 -33.

Sugnet, Chris. 1989. Beyond the online catalog. Library Hi-Tech 7(3): 81 -91.

APPENDIX B

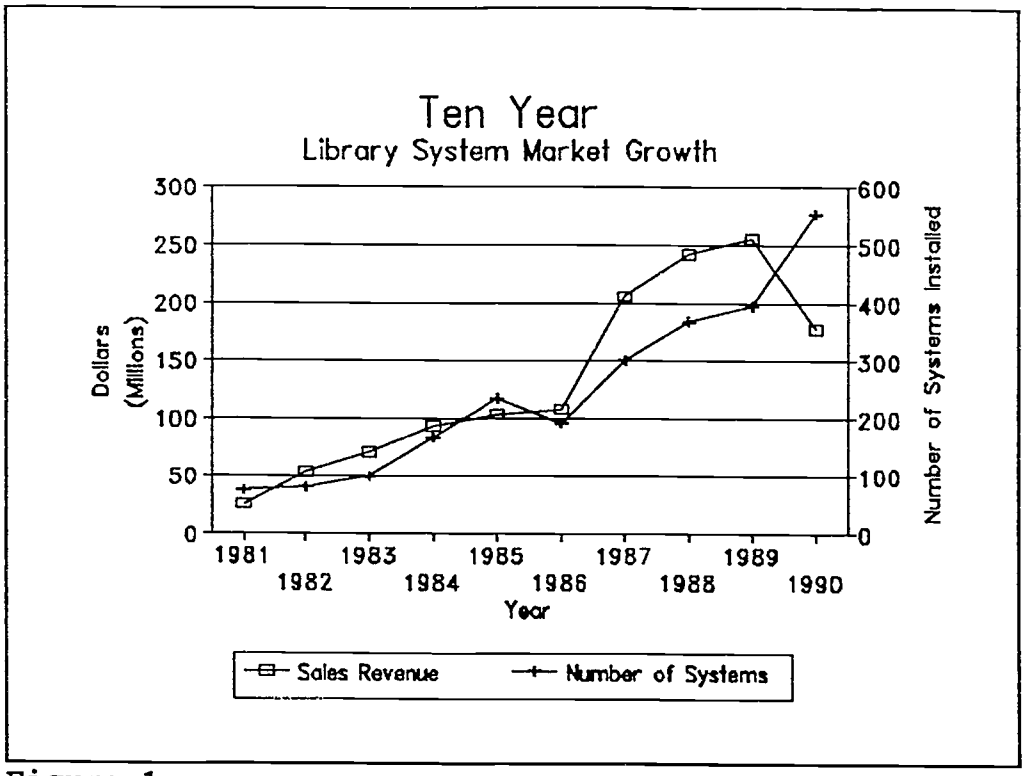
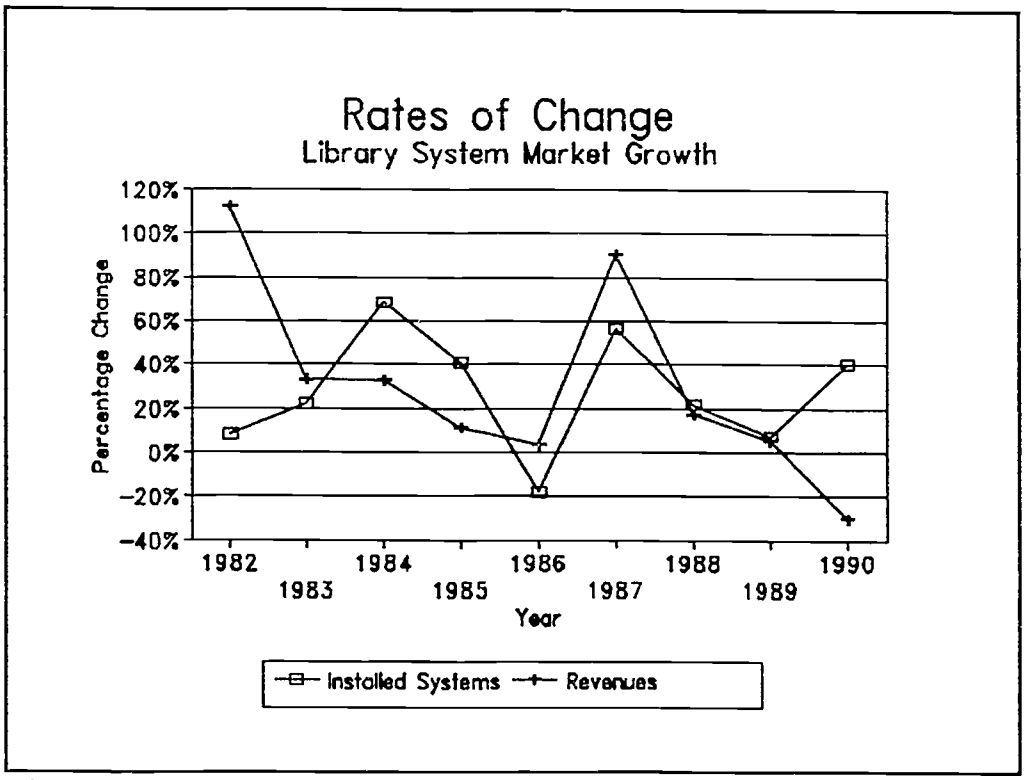


Figure 1



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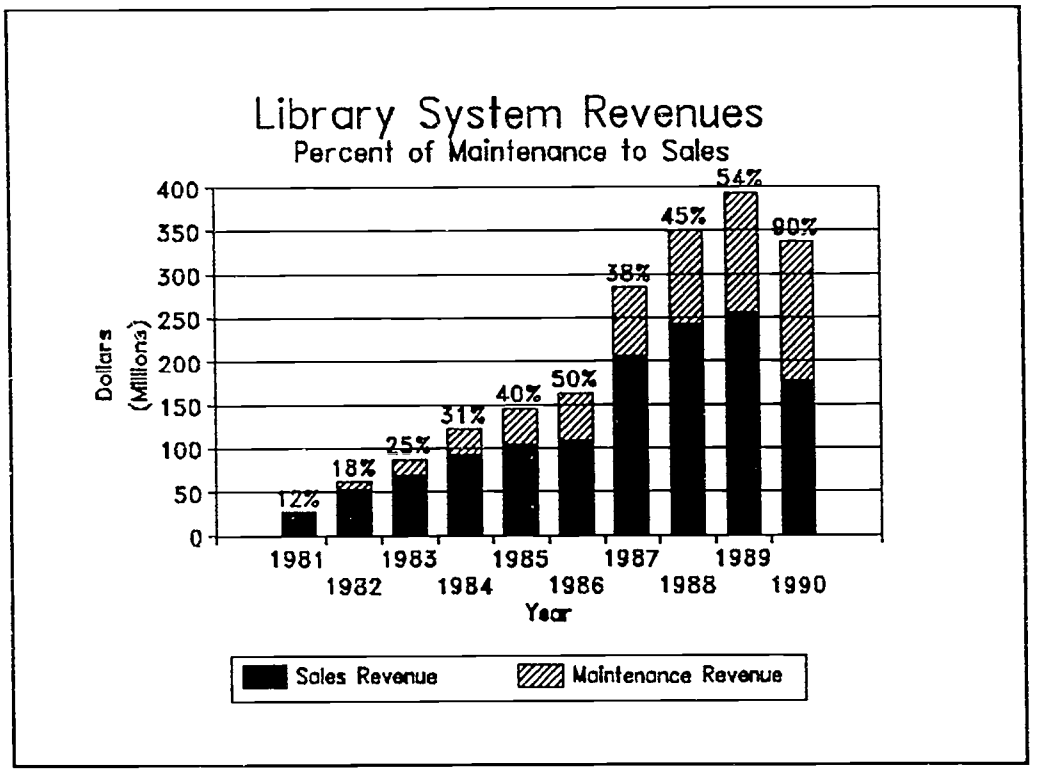

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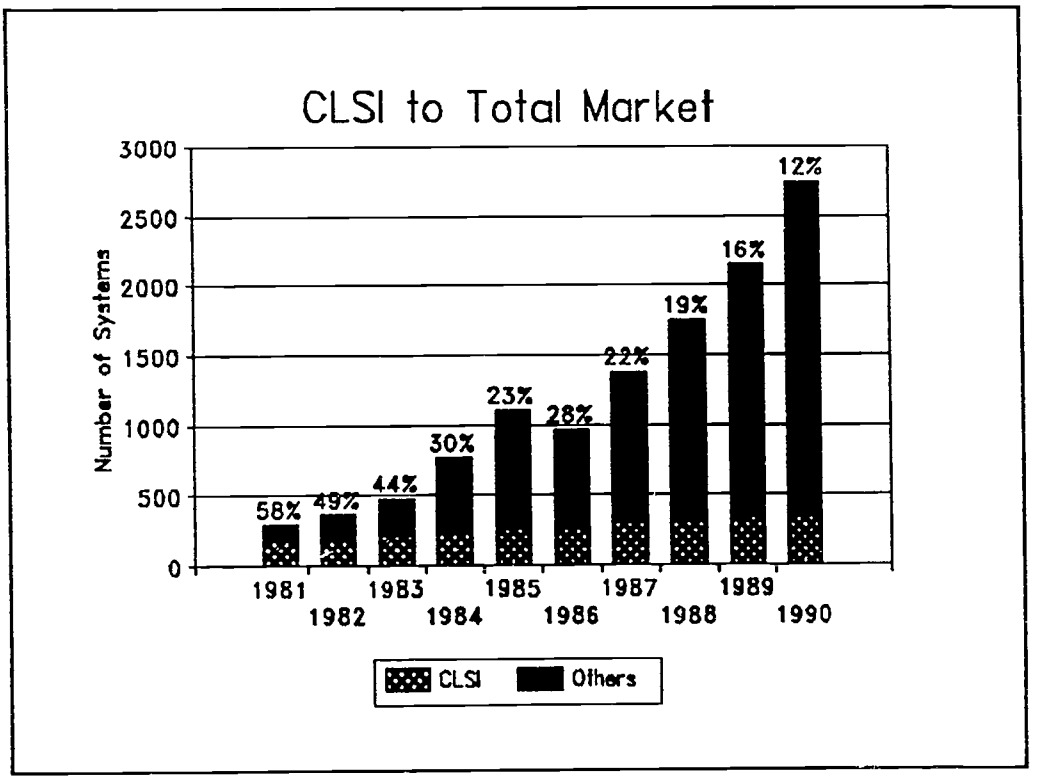

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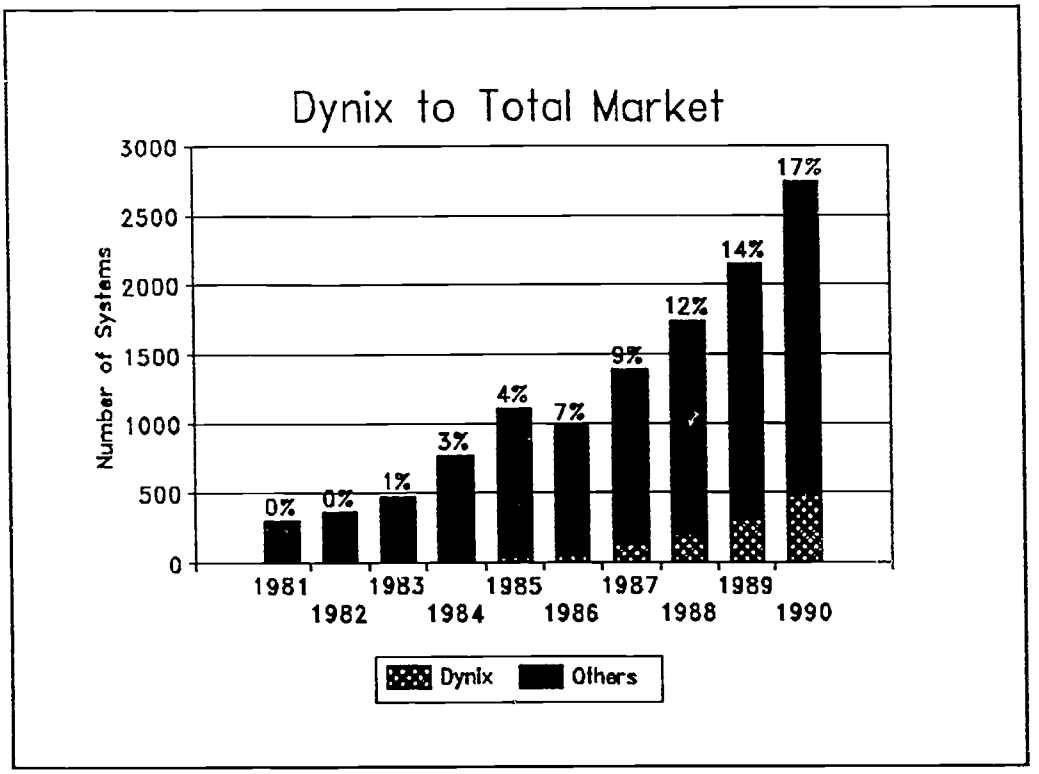

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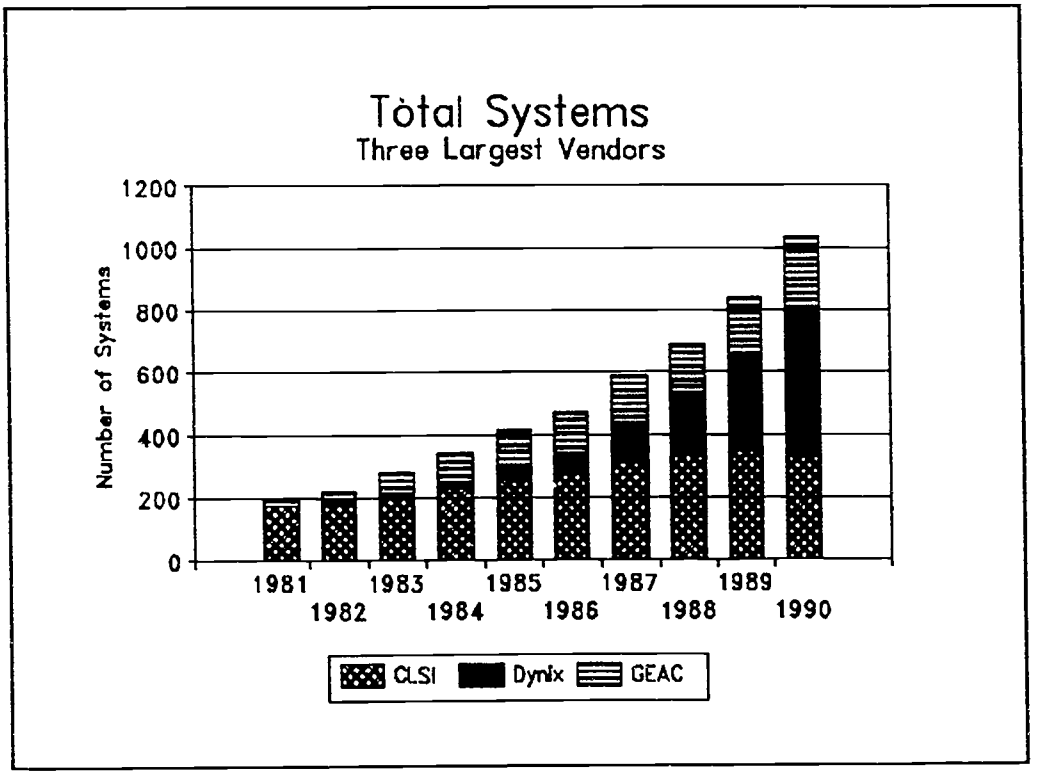

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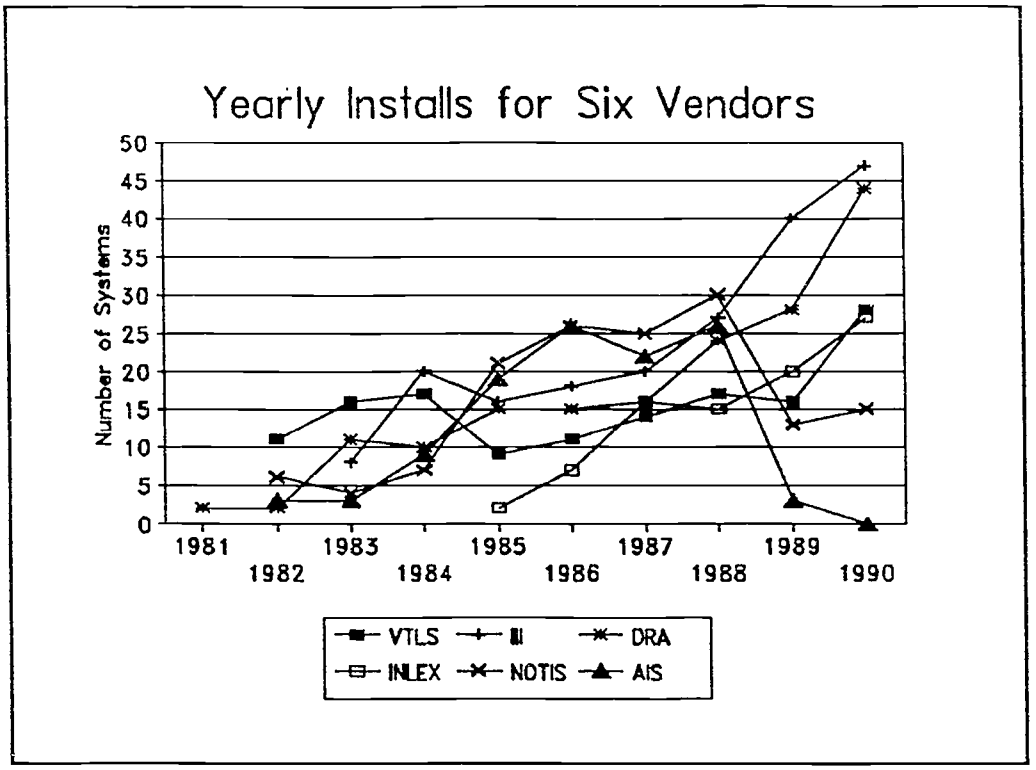

Figure 7

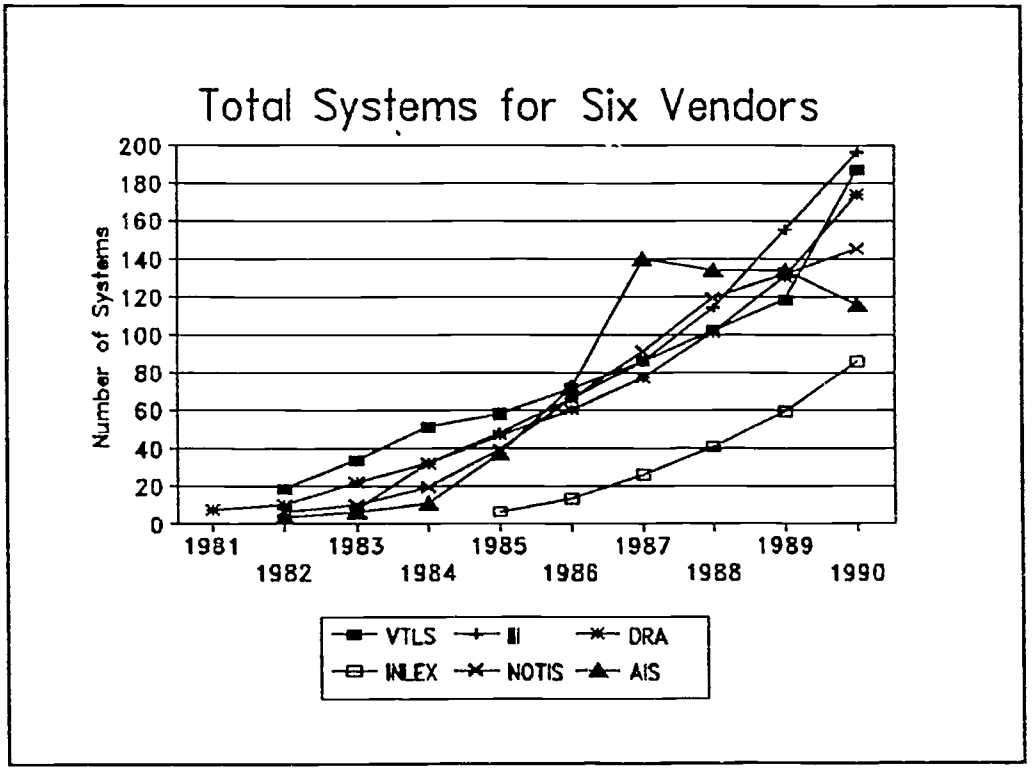

Figure 8