FUTURE DBMS MARKETS, 1987 - 1992

INPUT

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Market Analysis and Planning Services (MAPS)

Future DBMS Markets, 1987-1992

FUTURE DBMS MARKETS, 1987-1992

ABSTRACT

This report provides analysis and a five-year forecast for the DBMS market.

The forecast data provided includes market size and growth rates for DBMS products on micro, mini/departmental, and mainframe platforms. The base year is 1987.

The report describes issues and trends that are driving the growth of the market and focuses on functionality critical to the DBMS vendor success. Significant relational data base growth has occurred heretofore which is being augmented by distributed data base management systems growth.

Leading vendors are profiled to provide insight into how they are reacting to the opportunities available in the forecast period.

Business opportunities and recommendations are presented to focus on the requisite action necessary to participate in this fast-moving market.

This report contains 114 pages, including 23 exhibits.

FUTURE DBMS MARKETS, 1987-1992

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FUTURE DBMS MARKETS, 1987-1992

EXHIBITS

1 INTRODUCTION

I INTRODUCTION

A. REASONS FOR PREPARING THIS REPORT

- Data base management systems (DBMS) have become immensely popular in the micro arena, have had substantial growth in the mini arena, and are a mature (i.e., slow growth) market in the mainframe arena.

- Relational data base management systems (RDBMS) were introduced in the early 1980s and have become very popular in all three environments without totally excluding hierarchical DBMS.

- End users are now in a position to easily use RDBMS capabilities to quickly develop applications without a significant loss of productivity or performance and without the intervention of the corporate IS group.

- Today's DBMS capabilities are more easily able to spawn applications integral to the success of the corporation, departmental work group, or the individual, analogous to how VisiCalc, 1-2-3, dBASE, or desktop publishing improved the work ethic. These provide control and resources to the actual end user.

- Distributed relational data base management systems are now possible allowing data to be made available and useable at its source yet remain part of the corporate data base independent of geographical or physical location.

- These trends present both opportunities and challenges for vendors and end users. IBM, in particular, is in a position to dominate and control this strategic application area after having let independent vendors exploit the DBMS arena for over 15 years.

B. RESEARCH BASE

- INPUT has performed research and provided information in several reports in the past. Reports of particular value in this important area are:

  - Software Productivity, 1986.
  - Departmental Systems and Software Directions, 1986.
  - Market Analysis: Data Base Management Systems, 1985.

C. SCOPE AND METHODOLOGY

- This report focuses on the market requirements and driving factors for DBMS today and in the five-year planning horizon. It describes the strategic direction of vendors in their efforts to solve the needs of their users while attempting to increase their market position.

- A five-year forecast of the DBMS market is provided showing the micro, mini, and mainframe contributions.

- Several major factors have occurred requiring the vendors to improve their software offerings to maintain their installed base and penetrate/develop new business. These factors are:

- The accelerating requirement to provide "relational" DBMS (RDBMS).

- The emerging efforts to provide distributed relational data base management systems (DRDBMS).

- The requirement to provide a homogenous data base environment, i.e., provide a view of the data across dissimilar hardware and operating system platforms, i.e., micros, minis, mainframes.

- The importance of SQL as a standard.

- The awakening of IBM to the strategic importance of DBMS.

- The coupling of fourth generation languages (4GLs) to accelerate the user's application development.

- The emphasis of "on-line" applications requiring new levels of performance to satisfy throughput needs.

- The functionality enhancements required of the DBMS engine to support the new applications being developed to provide competitive advantage to the end user.

• The methodology employed in preparing this report was as follows:

- A critical analysis of previous INPUT and external research projects was made as was a literature search of INPUT's extensive files on DBMS, 4GLs, and vendor information.

- Vendor contacts were made with 20 significant leading edge vendors using the questionnaire in Appendix A. It should be noted that with minor exceptions the vendors were extremely open and candid in their remarks.

- Vendor contacts at the minimum were one hour interviews.

- An iterative approach was used to calibrate conclusions developed after the first calls to reaffirm the information previously received.

- INPUT considers DBMS and its future enhancements the major applications vehicle to be utilized across all industries and likely to become a generally useful tool for end users. This is predicated on relational DBMS having functional enhancements and performance improvements coupled with 4GLs for ease of applications development.

  - The selection of a distributed or relational DBMS is a decision that cannot be taken lightly in the corporate environment.

  - The corporate DBMS solution can be viewed as one that could well be a 10-20 year commitment.

- This report can be used by vendors and/or end users to:

  - Obtain strategic direction and insight for performance and functionality over the five-year forecast horizon.

  - Understand the heavy demands on hardware resources and applications architecture.

  - Provide for effective planning and control of their applications environment and assess the opportunities and markets available to future DBMS environments.

II EXECUTIVE OVERVIEW

II EXECUTIVE OVERVIEW

- Data base management systems have become a fast growing, user-oriented facility allowing important applications to be developed to better manage the business.

- Relational DBMS (RDBMS) environments have been offered to the user community allowing easier application development, more flexibility to enhance, and simple ways to view the users' data.

- Following closely on the heels of RDBMS are two major improvements--distributed RDBMS and on-line transaction processing functionality. These functional and performance improvements provide users with the ability to interact in a complete sense to satisfy the application needs local to the data source while allowing inclusion in the corporate data.

- This Executive Overview is provided in a ready-made presentation format. The exhibits are set in larger type for ease of use with an overhead projector, and the text is provided in script format. The script for each exhibit is contained on the left-hand page opposite the exhibit.

A. EVOLUTION OF DATA BASE MANAGEMENT SYSTEMS

- Data base management systems (DBMS) capabilities have improved significantly in the past five years in terms of functional capability, flexibility, portability, performance, and ease of use. Many tools have been added to facilitate forms handling, file management, and spontaneous query.

- Prior to 1985, the majority of DBMS applications used hierarchical-structured systems. Hierarchical DBMS applications were generally developed by the internal corporate programming staff due to the necessity of up-front design and the complexity of programming the application.

- As early as 1980, relational systems became available with the express purpose of allowing easier design and implementation and above all simplified redesign (i.e., the ability of extending or adding data fields without recreating the entire database). This provided users with an opportunity to get involved, especially as departmental systems useage grew.

- Distributed DBMS (based on relational concepts) allows the maximum flexibility to incorporate the data on different hardware and operating system platforms and/or locations as well as provide the simple application development and control of a relational system. This allows data to reside in the computing platform and location where it is captured or most frequently utilized.

- The late 1980s and early 1990s will see a broader and broader acceptance of relational DBMS that provide distributed and transaction-oriented capabilities facilitating departmental use of corporate data, and end user access to the corporate information assets.

- Exhibit II-1 summarizes the basic characteristics of the three categories of DBMS.

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EVOLUTION OF DATA BASE MANAGEMENT SYSTEMS

HIERARCHICAL →	RELATIONAL →	DISTRIBUTED
Highly Structured	Simply Structured, i.e., Tables	Simply Structured
Somewhat Inflexible	Very Flexible	Very Flexible
Difficult to Use	Easy to Use	Easy to Use
Reasonable Performance	Minimal Performance, Although Improving	Excellent Performance
Acceptable Functionality	Excellent Functionality	Totally Integrated Functionality
Centralized Data	Centralized Data	Decentralized Data

B. DBMS FUTURES

- There are numerous driving forces that are stimulating the development of DBMS environments. In Exhibit II-2, a list of the important requirements of a future DBMS are listed.

- Distributed/networked DBMS capabilities recognize departmental systems and workstations as emerging production platforms for corporate DBMS applications. This is due primarily to the cost of hardware to provide the necessary computing power (generally measured in million of instructions per second (MIPS)) to satisfy the application. In addition, departmental systems can support the data storage requirements to the application as well as be easily connected to other platforms.

- The enhancements called Relational+ include: fourth generation language (4GL); SQL support; integrated report modules; graphics, text, and document data types; spreadsheet hooks; expert system interface, artificial intelligence (AI) interaction hooks; and global dictionary support.

- There will be a significant interest in supporting standards namely the ANSI SQL as well as communication standards such as OSI and pseudo standards such as SNA. This will provide the ability to distribute the data as well as interconnect to other vendors' DBMS engines. Furthermore, most vendors will support IBM's DB2 product and essentially create a DB2 "market".

- The ability to easily port the DBMS engine to numerous platforms will be a critical factor for DBMS vendors to increase their market share. This "portability" will allow vendors to distribute data across numerous platforms and support more users.

- Open architecture provides the ability to coexist with other vendors' tools and DBMS engines and provides maximum user flexibility and independence to meet the application needs of their environment.

DBMS FUTURES

- Distributed/Networked/Interconnected
  - Dictionary Integrity, Data Integrity, Performance, Reliability, Platforms Supported (Transparency)
- Relational+ Functionality
- High Performance
- Standards Support
- Portability
- Open Architecture

C. DISTRIBUTED/NETWORKED DBMS

- The most important feature in the five-year forecast period is that provided by the distributed/networked capability. This feature allows the corporate IS manager to develop a DBMS strategy that provides for data to be captured and maintained at the source, be included in the corporate view of the data, and have maximum flexibility and control. This means that the corporate data plan can have data on different manufacturer hosts in different locations, thereby using hardware in a more cost-effective manner, minimizing the data movement (i.e., data will not have to be physically moved to a central site), yet maximizing the access and availability of the data.

- Managing data over several hosts/platforms allows for data redundancy, data flexibility, data availability, and end-user transparency to the data. The managing of data over several hosts allows the corporate IS manager to develop a data strategy providing: data redundancy; data flexibility; data availability; and end-user data transparency.

- Furthermore, the distribution of data allows more cost-effective hardware to be deployed to handle the resource requirements of the application. Throughput is improved while cost savings are incurred.

- The same functionality is provided to the users of the data through the underlying DBMS engine because the same DBMS is being provided on the hardware platform of the user of the data. Thus, if the user is on a particular brand of hardware, his view of the application environment is exactly the same as a user who may be on a different hardware system or in a different geographical location. No matter where the actual data are located, each user has the logical view that the data is on his hardware platform.

- Exact functionality is provided across different hosts/platforms, allowing users to avail themselves of consistent interface, application development, and functionality with the most appropriate resources available.

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DISTRIBUTED/NETWORKED DBMS

- Data Distribution
- Data Dictionary
- Price/Performance
- Consistent Functionality

D. FUNCTIONALITY IN FORECAST WINDOW

- Distributed/relational DBMS environments will provide additional functionality to allow new leading edge applications to be developed. Exhibit II-4 describes the necessary functionality in the future for a DBMS.

  - Text and document handling will be available in 1988.
  - Image/bit-map support available in 1989.
  - Initial implementations will be niche-oriented.
  - DBMS vendors will provide user data-type capability.
  - Referential integrity will become an important factor in data dictionary support.

- Complementary support will be provided by 4GLs, spreadsheets, artificial intelligence, and gateways to non-SQL DBMS.

- DBMS vendors believe that their supporting optical disk storage will be relatively easy since the optical disk storage support will most likely impact the hardware's operating system. This will make optical disk storage "transparent" to the DBMS vendor.

- Micro implementations supporting multi-users is viewed as an operating system consideration. When available, it should provide similar functional equivalence to mini/mainframe implementations.

- Based on performance improvements and the potential of the distributed/relational DBMS architecture, it is believed that off-the-shelf hardware will have no difficulty matching or surpassing the performance of proprietary hardware-based DBMS products.

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FUNCTIONALITY IN FORECAST WINDOW

- Data Types
- Spreadsheet Hooks
- 4GL Interface
- Optical Disk Storage
- Multi-User Micro Implementation
- Proprietary Hardware Growth Suspect
- Gateways to non-SQL DBMS
- AI Interface

E. COMPANY PROFILES—TEN SIGNIFICANT PARTICIPANTS

- IBM is by far the revenue leader as a DBMS vendor. Its duel strategy has caused competitive consternation for the mainframe independent DBMS vendors who, ironically, seem to be embracing a similar strategy.

- The leaders in developing relational and distributed DBMS are fast-growing companies that have brought products to the market in the 1980s. Coincidentally, these companies are located on the West Coast. The majority of IBM's DBMS development activity is also located on the West Coast. See Exhibit II-5 for the campanies profiled in this report.

- The mature DBMS vendors have been following the leaders (thereby, they are called "followers") in providing the latest DBMS technology. This is not surprising in that they are mature vendors with large installed bases generally in the mainframe environment that are encumbered with the following:

  - Retrofitting of products.

  - Maintaining installed base control.

  - Migrating to new functionality.

- Followers have been somewhat behind but seem to be making strategic plans to catch up. Many are introducing new relational products, migrating to other platforms, and attempting to leverage their installed base.

- The companies profiled are ones that have made a major impact in the DBMS market and are likely to participate in the substantial growth being forecast.

- Each profile will cover: background, recent revenues, recent events, and strategies and analysis.

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COMPANY PROFILES: TEN SIGNIFICANT PARTICIPANTS

Mainframe

Applied Data Research
Cullinet
Cincom

Mini/ Departmental

Oracle
Relational Technology
Informix

Micro

Ashton-Tate

Tools, Etc.

Information Builders

Emerging

Sybase

General

IBM

- Some Are Leaders
- Some Are Followers

1-SC4

F. FORECAST FOR DATA BASE MANAGEMENT SYSTEMS, 1987-1992

- The DBMS market will grow from $2.2 billion in 1987 to $5.8 billion in 1992. This growth is due to the growth of the computer industry in general and the ease of use of relational DBMS products. This allows many more individuals to develop applications using a DBMS without requiring the use of internal corporate programming staffs. Exhibit II-6 shows a breakdown of the growth by micro, mini, and mainframe environments.

- Most of the new DBMS users and developers will be on mini/departmental systems and/or micro systems. These environments will account for the majority of the growth.

- The micro systems environment is forecast to grow from $525 million in 1987 to $1,800 million in 1992, an annual growth rate of 28%.

- The mini/departmental systems environment is forecast to grow from $510 million in 1987 to $1,900 million in 1992, an annual growth rate of 30%.

- In 1987 the micro and mini/departmental systems account for 47% of the DBMS market. In 1992, these two environments will account for 64%.

- While the mainframe environment is only growing at an AAGR of 12%, it still will remain the largest portion of the DBMS market, reaching $2.1 billion in 1992 from a base of $1.2 billion in 1987.

- Distributed DBMS and on-line transaction processing as part of relational DBMS will fuel the growth with relational DBMS use representing 50% of the DBMS architecture sold in 1992. At that time, distributed DBMS will have a 15% market share.

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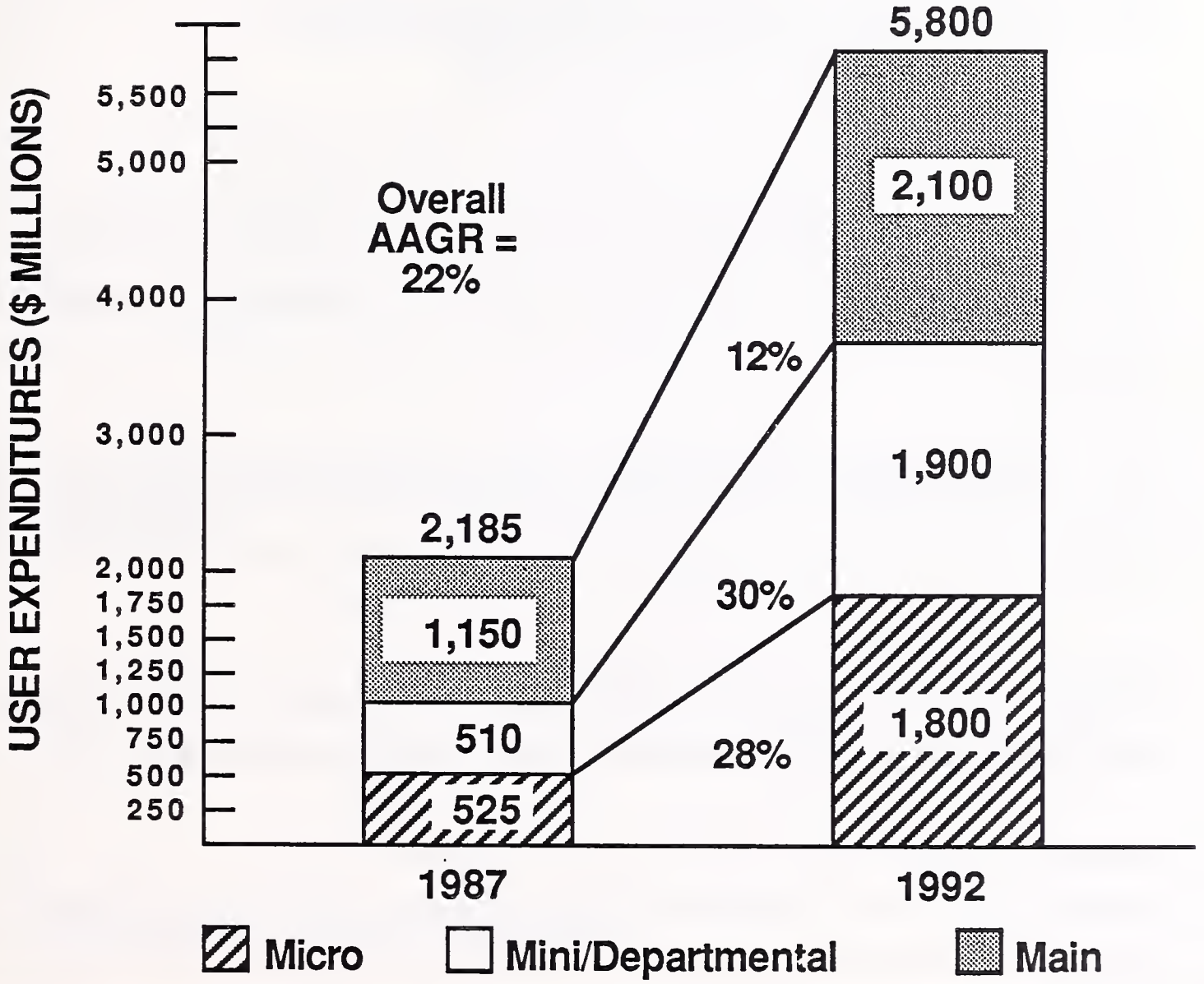
FORECAST FOR DATA BASE MANAGEMENT SYSTEMS 1987-1992



G. JOINT MARKETING/STRATEGIC RELATIONSHIPS

- The DBMS product has become the underpinning of most major applications and is utilized as a replacement for the file system.

- This has caused application developers to formulate marketing arrangements with the DBMS vendor to formalize the use of the underlying DBMS and become intimate with the DBMS vendor's developments.

- Computer manufacturers have developed strategic relationships and independent vendors have acquired companies to obtain technology to satisfy their strategic needs. This is especially true for those vendors who had only a mainframe strategy and were caught blindsided by the move to relational systems, user acceptance of departmental systems, and IBM's aggressive marketing.

- INPUT believes there will be some power shifts occurring in the five-year forecast period and there is considerable potential for several new emerging companies to make significant market share penetration.

- There will be an increase in the number of strategic relationships to complement computer manufacturers' needs to support foreign platforms.

- Examples are the IBM/LOTUS relationship which on the surface is for 1-2-3. However, LOTUS has a development effort underway for a relational DBMS in the micro environment which by virtue of the strategic relationship could be available to IBM. Unisys has contracted with Sterling Software to enhance its DBMS offerings.

- Most of the mature DBMS vendors have developed or acquired SQL technology to add to their mainframe DBMS products.

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JOINT MARKETING/STRATEGIC RELATIONSHIPS

- **DBMS is Key Factor in Applications Development**
- **Relational/Distributed DBMSs Especially Flexible**
- **Hardware Vendors/DBMS Vendors Announce Co-Marketing/Joint Marketing Relationships**
- **Strategic Relationships**

H. STRATEGIES AND RECOMMENDATIONS

- The largest growth will be in the mini and micro markets.

  - Getting entrenched in this arena will be easier as the decision makers are not IS manager types and will be open to new capabilities.

  - IBM is poised to have excellent growth and control in the IBM mainframe area. Its dual strategy of IMS and DB2 is working well.

- The DB2 product will itself become a "market", and there will be opportunities to play in complementary areas. This complementary strategy is clearly not a DBMS strategy except it could pull through sales to the vendor's mini or micro DBMS product.

- Strategic partnering should not be overlooked as an effective way to become involved and grow in the DBMS market. Partnering considerations should include applications vendors and computer manufacturers.

- New applications and tools will help differentiate the DBMS vendor. Consider offering complementary products that utilize the DBMS engine. Examples are:

  - Integrate natural language or knowledge-based capabilities.

  - Integrate Computer-Aided Software Engineering (CASE) methodology.

  - Offer full services consulting to assist in applications development.

- Investigate new pricing mechanisms. Consider partial license of the DBMS when used by an application vendor and asing plans.

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STRATEGIES AND RECOMMENDATIONS

- **Participate in non-IBM Environments**
- **Participate in DB2 "Market"**
- **Develop Strategic Partners**
- **Develop Applications and Tools Base**

III MARKET ANALYSIS AND FORECAST

III MARKET ANALYSIS AND FORECAST

A. HISTORICAL PERSPECTIVE

- In the mid-1970s most data base engines had an hierarchical or inverted list structure. Examples are IBM's IMS, Cullinet's IDMS, Cincom's TOTAL, Mathematica's RAMIS, Software AG's ADABAS, Information Builder's FOCUS, ADR's DATACOM/DB, DEC's DBMS, MRI's (now SAS) SYSTEM 2K, and others.

- These data base management system capabilities require significant system analysis, planning, data record layout, and programming expertise to effect a production application. This necessitates the use of the corporate programming staff since the above-mentioned skills are not generally found in the end-user community.

- This has resulted in an applications backlog and long delays before the end user can benefit from the computerization and productivity benefits of the application. In addition, the applications with the most impact or biggest payback were the ones implemented with the finite resources each corporation possessed. The average end user had little recourse.

- Based on some research at universities, most notably the University of California-Berkeley and IBM research at San Jose (Project R), mathematical models were developed to provide a different data base architecture or structure to allow for simple representation. This allowed easier data base

management system-based applications to be developed by the end user. The IBM research resulted in two major piece parts:

- A relational data base structure defining a simple-to-use DBMS.

- A definition of an inquiry and data manipulation capability called structured query language (SQL).

- Application generators that could take simple expressions of logic and generate application programs (usually producing COBOL) started to emerge on the scene as ways to improve application development productivity.

- In the late 1970s and early 1980s, new companies were formed to harness the research that had been developed into commercial products. Thus, companies such as Oracle, Relational Technology, and Informix were formed.

- At the same time, minicomputer systems were becoming more powerful with larger memory, disk, and computer processing power and were able to more effectively solve departmental application requirements in a cost-effective way. These systems were inherently closer in both proximity and application potential to the end user. This resulted in the end user obtaining:

  - More control over the applications and data important to that department's work.

  - The responsibility to procure application solutions for the "local computer environment."

  - The potential to use "simple interface" DBMSs of the relational flavor.

- The evolution of relational DBMS is shown in Exhibit III-1 which shows the early implementations to be based on "pure" relational concepts. Exhibit III-2 shows implementations by others that were in most instances reconstituted to

INITIAL RELATIONAL IMPLEMENTATIONS

YEAR	COMPANY	PRODUCT	PLATFORM
1975	Tymshare (now McDonnell Douglas)	Magnum	DEC System 10
1975	NCSS (now D&B Computing)	Nomad	IBM 370/168
1979	Oracle*	Oracle	DEC VAX/VMS
1981	Relational Technology	Ingres	DEC VAX/VMS
1982	Relational Data Base (now Informix)	Informix	DEC VAX/Unix
1983	IBM	DB2	370 Family MVS

*Oracle was the first to implement Structured Query Language (SQL)

EXHIBIT III-2

OTHER RELATIONAL IMPLEMENTATIONS

COMPANY	PRODUCT	FORMER PRODUCT
Cullinet	IDMS/R	IDMS
ADR	Datacom/DB	
Software AG	ADABAS*	ADABAS
Cincom	SUPRA**	Total
DEC	VAX Rdb/VMS	VAX DBMS
HP	ALLBASE	Image
Mathematica (Martin Marietta, then On-Line Software)	Ramis II	Ramis

* Software AG has not reworked ADABAS but provides hooks into other relational systems
** Cincom's SUPRA is based on a relational foundation

provide the look and feel of relational at the user interface level. These "born-again" DBMSs (a term used in Dr. E. F. Codd's Computerworld articles of October 1985) ostensibly provide the user with:

- The advantages of relational. By providing user level relational concepts which get processed into the original underlying technology, be it hierarchical or inverted list, it is some consultants' view that the user is being served an injustice. This means that "true" relational concepts down to the core of the data base engine are not being used and, therefore, the "born-again" DBMS is not truly relational.

- It is INPUT's belief that this "truth-in-advertising" argument is not valid as long as the user is able to satisfy the application requirements. If there is some inherent relational feature that one presupposes is not available, then the purist view is valid and full disclosure must be made.

- All RDBMS vendors have received complaints regarding the performance of applications utilizing relational concepts. There has been considerable improvement over the past few years with more likely in the future. It is highly likely that the "born-again" RDBMs will be unable to benefit from optimization techniques developed for the underlying relational model. This may be the real point.

- Simultaneous with the advent of RDBMS was the development of "tools" to complement the RDBMS and provide a more productive environment. These tools included fourth generation languages (4GLs) as well as support for SQL, screen handlers/formatters, data dictionary, and micro/mini and micro/mainframe communication links. In fact, some of these tools were being developed by the original DBMS vendors to enhance their applications environment.

  - It should be noted that one of the first instances of the use of the term 4GL was to describe the flexibility and tools available in Information Builder's Focus, in an article in Datamation in 1981.

- The provision of tools has become standard with the newer RDBMS vendors as a mechanism to facilitate procurement and use in their targetted markets, i.e., mini or departmental class computer systems.

- Independent vendor activity has been in the mini, mainframe, and micro market with most vendors migrating their products to additional platforms. This phenomena has occurred over the past few years and is based on the realization that corporate environments are selecting platforms that offer the most price/performance for their application requirements. The following factors are driving this migration:

  - Corporations are not as dedicated or committed to a specific hardware vendor purchasing assorted hardware to fill their needs.

  - There is significantly more competition for the IS computing budget due to the recent computer purchasing "slowdown."

  - To be the corporate data base vendor, one needs to support the computer platforms of the customer.

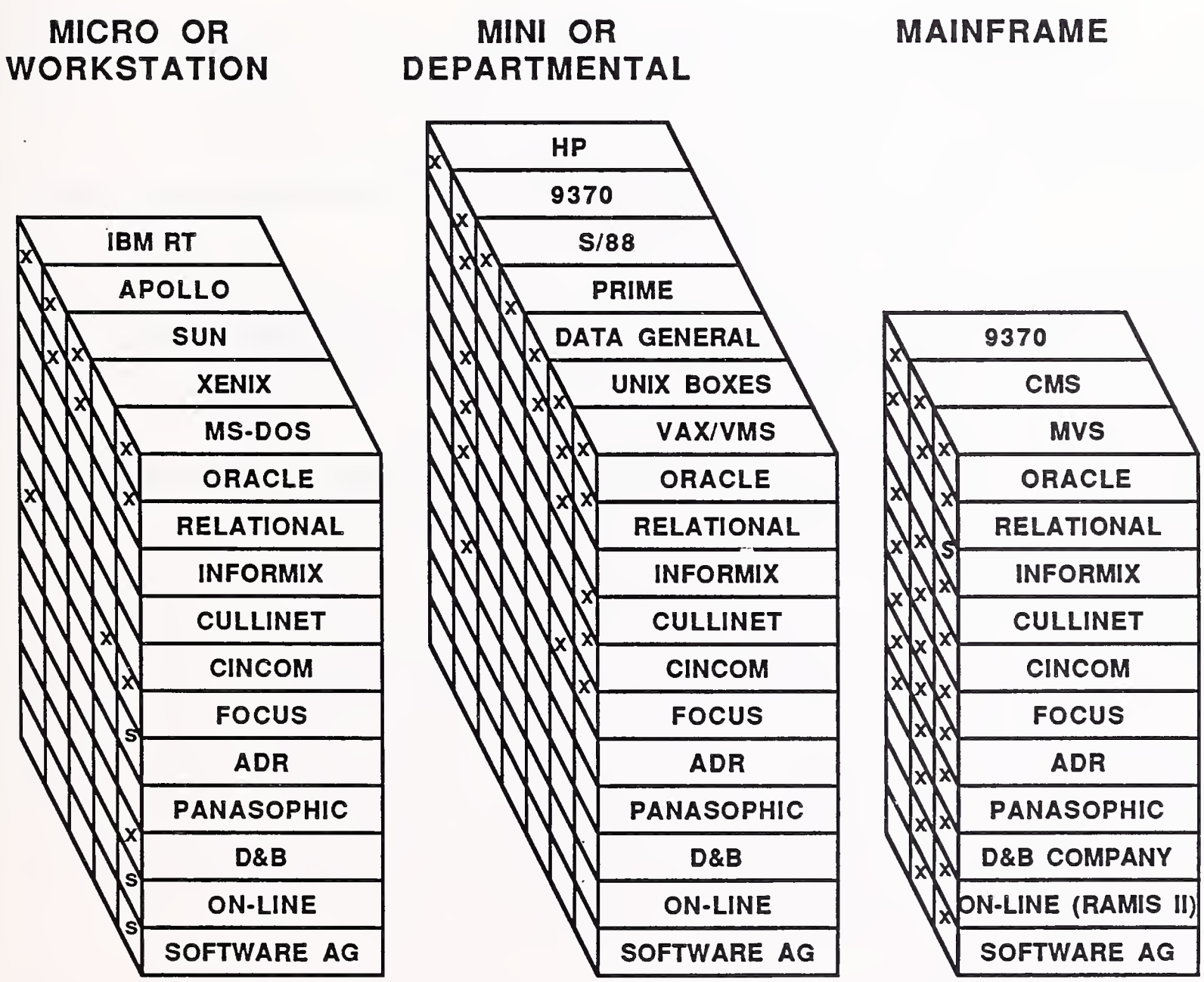
- Exhibit III-3 depicts some of the migration flux of the independent vendors that has been going on in the past few years.

B. CURRENT STATUS

- The corporate data processing environments are continuing to procure computer systems that are most appropriate for the environment and application and provide maximum price/performance. This has led to a significant growth of the traditional mini or departmental computer vendors, most notably DEC, Prime, and Data General. This, of course, led to the recent IBM announcement of the 9370 to stave off the encroachment of these vendors into IBM's

EXHIBIT III-3

MIGRATION FLUX OF SEVERAL INDEPENDENTS



X = Can run application in the platform
S = Provides support for linkage or inquiries to another environment

commercial sector, a province that had been controlled by IBM for quite some time.

- It is also clear that corporations are making selections for the micro platform and are specifying software dictates and/or recommendations to obtain economies of scale for price, support, and data compatibility. The majority of corporations are accepting the IBM PC or PC-compatible as the micro of choice. The recent PC/2 announcement has enhanced this position.

- The current market and/or business conditions will be discussed in the three main computing areas:

  - Micro class - consisting of PCs, PC-compatibles, workstations, or intelligent terminal devices.

  - Mini or departmental class - consisting of VAX, Data General, Prime, and IBM 43XX or 9370.

  - Mainframe class - consisting of the IBM 370 family, 30XX, and others.

I. MICRO CLASS

- Most of these users selected a local data base solution as a means to meet their personal needs in using data they possessed or had permission to access and download from the corporate computer system. Basically, there have not been many corporate dictates on what hardware or software to use and no requirement of which micro to use. This laissez faire attitude created numerous problems regarding DBMS applications:

  - The view of the data was not always in synch with the corporate data.

  - Who controlled what data was available to whom were questions that were continually raised.

- How could real data at the micro be uploaded and integrated into the corporate data.

- Aside from these issues of security and control, a significant additional concern was the ability to have a consistent user interface and all the application power and flexibility of the mini or mainframe DBMS to which the micro system connected. Besides, the data was in a different format and data conversion was likely required.

- Most micro users obtained Ashton-Tate's dBASE family of products. There are numerous other vendors who supply data base solutions in the micro arena. Very few of the vendors that started out in this platform provide a relational structure or the complementary tools.

- Recently, Ashton-Tate announced its next release of dBASE would support SQL. It is believed the next release will not be available until the enhanced version of OS/2, sometime in 1988.

- A number of significant vendors have ported their software to the micro arena to take advantage of their market presence offering micro users compatible functionality and the same user interface. Among these are Oracle, Relational Technology, Informix, Information Builders, and D&B Computing. Other major vendors are taking a hard look at the micro opportunity.

- Even IBM has announced as part of its recent major PC/2 "wave" its intention to have DB2 and SQL support in the second release of OS/2. Unfortunately, the availability date of that release will not be announced until third quarter 1987. IBM providing DB2 and SQL support on the PC coupled with other controlled leaks of a distributed data management architecture could mean it is getting the entire message of what users seem to be expressing.

- The IBM announcements also show a serious attempt to execute and make real its recent System Application Architecture, at least for the 286 and 386-based

PCs. It is not clear what the millions of PCs and PC-compatibles do to play in this architecture.

- Finally, the real threat in the PC arena may come from Lotus and/or Microsoft who must be anxious to participate in the strategic benefits of a data base plan. Microsoft has struck a business relationship with Sybase (Berkeley, CA) to effect such a strategy. Sybase's product family can almost be viewed as a second generation relational DBMS that is oriented toward solving the on-line- and/or transaction-oriented RDBMS application requirements. There is no doubt the original RDBMS vendors are actively working on this key application characteristic, i.e., OLTP and distributed.

2. MINI/DEPARTMENTAL CLASS

- This is the environment where most of the fast changing leading edge relational vendors obtained their start and momentum. The prime factor was based on DEC having remarkable success in the early 1980s selling the VAX line of equipment into the engineering and commercial sectors.

- However, DEC's DBMS was ineffectual in meeting the application needs of the departmental users due to the lack of integrated support tools. Ergo, the success of Oracle, Ingres in the VAX/VMS arena, and Unify and Informix in the UNIX environments. This success and momentum allowed these vendors to embark on migration strategies and functional enhancements to solve the corporate data base requirement and support data distribution.

- The ease of development, flexibility, and adequate performance inspired the corporate IS managers to support limited use of these DBMS in the mainframe environment and provide endorsement in the micro environment. The departmental groups (and end users) have been extremely pleased with their success with relational DBMS applications in their arena.

3. MAINFRAME CLASS

- This is the environment where the going gets tough. While some corporate environments may be looking at or getting some initial use out of the migrated RDBMs to that environment, it is safe to say that the jury is still out.

- There is a great deal of interest in the distributed data base story that abounds in the press and marketing literature of the relational vendors, but there are not many corporate users that have committed to or understand the true benefits of distributing the corporate data base.

- It is INPUT's belief that the distributed data base management application as described in its most general terms may be more a twinkle in the eye than the true need being expressed by corporate America.

- There are several important factors that must be considered before the "theoretical" concept of distributing data bases and dictionaries over several manufacturers' computer systems really takes place (in significant numbers). The factors are:

  - The corporate data czar understanding how, why, and what the true benefits are of distributing the data to begin with using this technique.

  - The corporate data czar believing that there is adequate control and protection to the data. It is one thing to embark on a distributed data strategy in VAX clusters because DEC has no competitive mainframe computer system and this strategy models the mainframe environment. It is yet another to suggest that these machines be physically and geographically separated. We are talking about "corporate data", and it is INPUT's belief that the corporate IS manager will have an extremely difficult time letting go on machines of like parentage. And then you want this data to be on different manufacturer's hardware?

- The new leading edge relational companies are demonstrating their ability to understand the mainframe environment (i.e., in most cases one can substitute IBM for mainframe) and convince senior management they can keep up with all the flux commonly found in the IBM world.

- The ability to support the operating systems and their evolution and demonstrate the performance potential necessary to satisfy the on-line DBMS applications that currently are supported by IMS. IBM has a dual data base strategy, maintaining that IMS is most effective for on-line data base applications and DB2 is best for inquiry and analysis or light commercial data processing.

  . Several of the leading edge vendors have expressed there is more to the mainframe world than seems apparent at first glance. The mainframe environments are significantly more complex than the typical departmental environment from where they came. This suggests a feeling of being somewhat overwhelmed.

  . The existing (mature) mainframe vendors who have been going "toe to toe" with IBM for years understand the environment and its support requirements, and the biggest is no more than $120 million a year.

  . The recent creative marketing practices of IBM are difficult to reckon with, and there is no doubt about the strategic positioning for DB2 and the account control it represents for IBM.

  . Finally, the famous FUD (fear, uncertainty, and doubt) that IBM can carefully convey to prevent or stall a competitive loss. No doubt future hardware and operating systems could have an impact on the evolution of the corporate DBMS, and would it not

be a shame if you were not able to take advantage of these technological gains? Remember, the data base decision is viewed to be a 20-year commitment.

- It is INPUT's belief that the successful DBMS vendors over the five-year planning horizon must be in a position to solve the DBMS requirements over the three main platform categories discussed above. Further, it is INPUT's belief that the mini/departmental platform is still up for grabs and that DBMS vendors that can support DEC, H-P, Prime, Data General, etc. may be in a more favored position to win the corporate sale.

- It is INPUT's belief that the resources required to support large-scale RDBMS requirements are immense and that responsible corporate IS managers will take a hard look at the economies of distributing data. This is due to the cost per MIP of workstations and departmental/mini systems being so superior to the mainframes. Distributing data may become an economic justification issue.

C. FUTURE DEVELOPMENTS

o DB2, IBM's RDBMS offering, and SQL will have enhancements which will impact the market. Below are some driving factors and crystal ball views of developments of these two important capabilities.

1. DB2 FUTURES

- DB2 will create its own market for tools, applications, and SQL enhancements.

- All IBM mainframe applications vendors will support DB2.

- Other independent vendors will structure to allow applications developed for their DBMS to be portable to DB2.

- DB2 will (someday) approach the performance/flexibility offered by the DBMS independents. Then the issue will be price and tools.

- DB2 will not be ported outside the IBM environment.

  - While this should be construed as a negative, it is countermanded by the success that SQL will enjoy in the other environments allowing interaction with other DBMS.

  - Noncontractual strategic relationships will be in effect with the technological relational leaders (i.e., Oracle, Relational, Informix, Sybase).

2. DB2 TIMETABLE PREDICTIONS

- In 1988, IBM will finally implement a data dictionary.

- In 1988, CSP (Cross System Product) will be enhanced to have adequate functionality but will still fall short of the functionality (and productivity) available from other vendors' 4GLs. Simply stated, tools have never been IBM's forte.

- In 1989, IBM will unveil its distributed RDBMS based on DB2.

3. SQL FUTURES

- In 1987-1988, the federal government will require SQL support for major procurements.

- In 1988-1989, all vendors still actively engaged in the DBMS/4GL market will support SQL or effectively be a nonparticipant.

- In 1989-1990, the SQL standards group will have discussions to support new capabilities such as:

  - Natural languages.

  - Artificial intelligence.

  - User interface conventions.

  - Data dictionary interfaces.

D. MARKET FORECAST

- INPUT believes the DBMS market is fundamentally a sound market and will remain healthy over the five-year forecast period.

- The largest growth will occur in the mini/departmental and micro markets, each more than tripling. The mainframe market is expected to almost double.

- Fueling this growth is the realization that the current relational DBMS products when coupled with the tools that support them allows for quicker applications development.

- In addition, a number of the newer DBMS vendors have been announcing products that allow distributed data bases to be deployed across disparate computer system manufacturers' hardware.

- In addition, the functionality of the RDBMS is growing, and there is a noticeable improvement in throughput, allowing more transaction-oriented applications to be possible.

- Exhibit III-4 shows the five-year forecast for user expenditures broken out over micro, mini, and mainframe use. The growth rates for each are 28%, 30%, and 12%, respectively.

- As mentioned, INPUT believes there is an important shift taking place in how RDBMS are being used and the trend to distributed RDBMS (DRDBMS). Exhibit III-5 shows the breakdown of the DBMS architectures over time.

- Exhibit III-6 shows the DBMS architecture breakdown in 1987 and 1992 by platform, i.e., micro, mini, mainframe. The following comments interpret the information in the table:

1. HIERARCHICAL

   a. Micro

- Use of 90% diminishing to 50%. Local use is based on price sensitivity and will primarily remain inexpensive flat file-oriented programs for corporate personal use.

   b. Mini

- Revenue goes from 70% diminishing to 20% as the new data base vendors make a firm foothold joined by the IBM mainframe "followers" migrating down to the mini platform.

EXHIBIT III-4

DBMS USER EXPENDITURES, 1987-1992

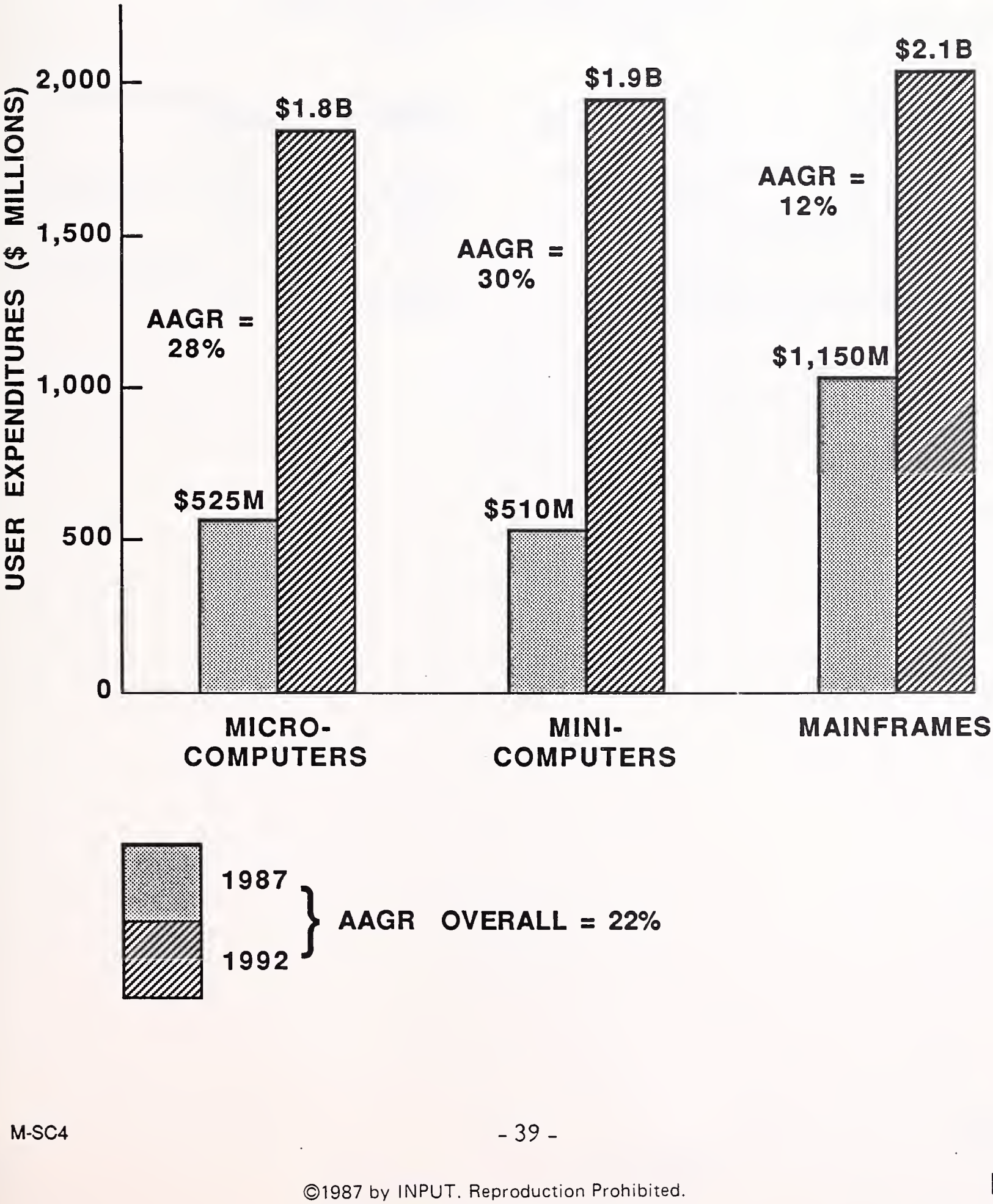


EXHIBIT III-5

DBMS ARCHITECTURES OVER TIME

	1970s	1980s	1990s*
Hierarchical	100	78	35
Relational	*	20	50
Distributed	—	2	15

*1992

EXHIBIT III-6

DBMS ARCHITECTURE BREAKDOWN BY PLATFORM, 1987-1992

	MICRO	MINI	MAINFRAME
Hierarchical	90/50	70/20	89/35
Relational	9/35	27/60	10/55
Distributed	1/15	3/20	1/10

1987/1992

c. Mainframe

- User expenditures drop off from 89% to 35% as IBM DB2 dominates the IBM world in new applications. The old proven existing applications will be very slowly converted to relational/distributed architecture.

2. RELATIONAL

a. Micro

- Significant growth will continue in the micro platform environment based on the general value of relational DBMS and its user convenience. The growth of DBMS is viewed as analogous to the spreadsheet phenomenon that has taken place in the past decade.

b. Mini

- Growth from 27% increasing to 60% makes relational systems the dominant DBMS architecture form.

c. Mainframe

- Relational systems will have significant growth in the new applications area and be used for applications development. The revenue growth will go from 10% to 55% of a revenue level double that of 1987.

3. DISTRIBUTED

a. Micro

- Fifteen percent of the expenditures in 1992 will be for applications where the data is contained on the micro in original source form and is local to a larger data base on another platform. It should be noted that this is a significant

volume of micros that are being used to accomplish this task as the total revenue dollars for micros is approximately that of mainframes, but the dollars per copy of the mainframe software are two orders of magnitude of the micros dollar per copy (i.e., $100,000 to $1,000).

b. Mini

- Similar to the micro, the minicomputer environment will grow significantly in the distributed RDBMS environment and represents an appreciable number of platforms.

c. Mainframe

- While there is smaller unit growth in the mainframe environment, the expenditure level is still meaningful.

- The basic reason for the substantial growth of the micro and mini platforms for distributed RDBMS is largely due to the dollar/MIPS performance factor these platforms represent when contrasted with the mainframe. In addition, the amount of local storage available to these platforms is not as limiting a factor as it had been in the past.

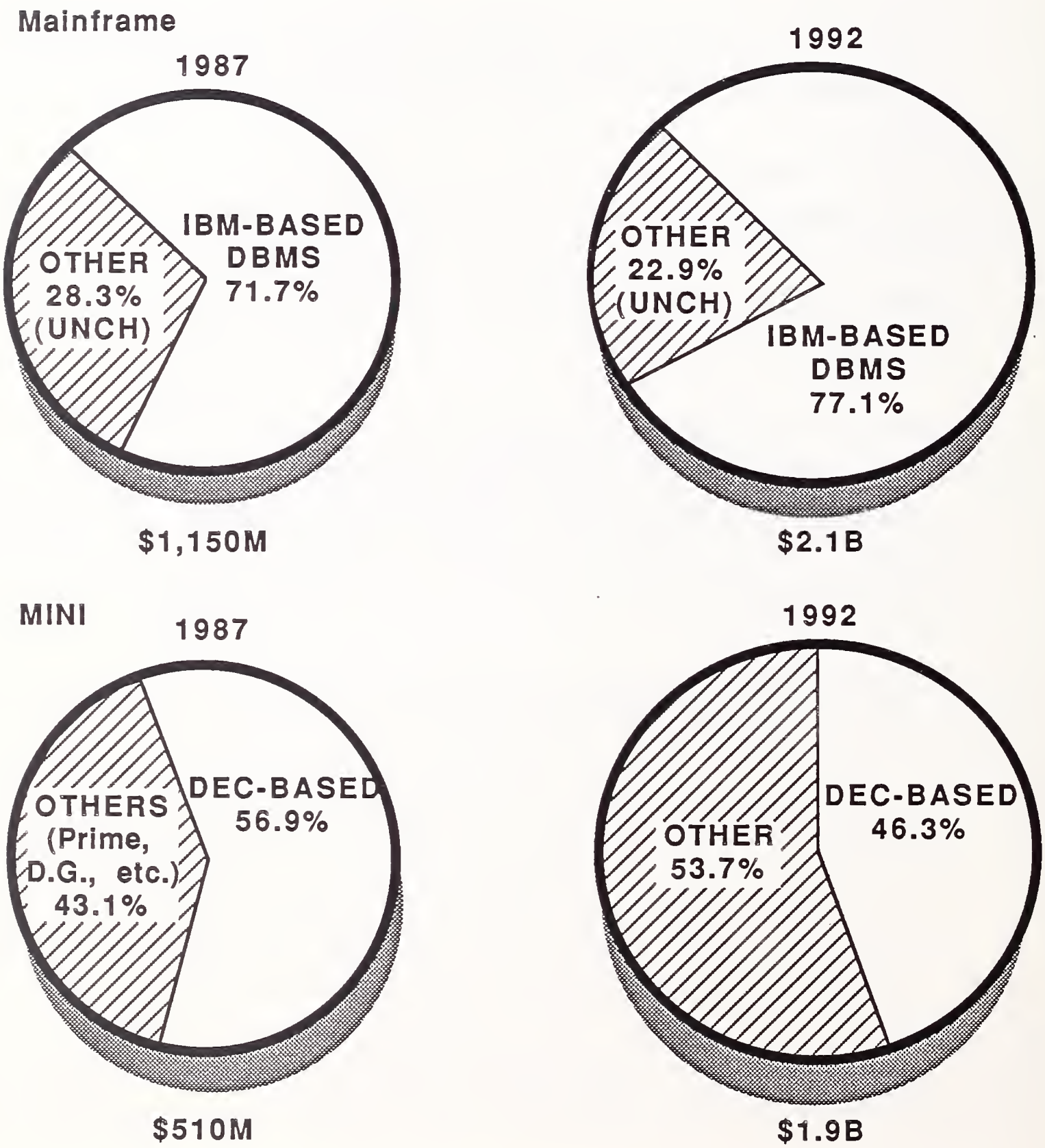
- Exhibit III-7 shows the DBMS expenditures broken out in terms of the mainframe and mini platforms.

- As expected, the IBM mainframe with IBM and the independent vendors dramatically dominate the mainframe environment. Interestingly, over the five-year timeframe INPUT is projecting that the IBM-based DBMSs will grow in market share in large measure due to the strong growth IBM itself will have; that is, IBM will gain market share in the mainframe environment.

- In the mini environment, DEC-based pl forms currently has over 56% of the market. It is forecast that DEC-based platforms will lose more than ten

EXHIBIT III-7

DBMS BY VENDOR-BASED PLATFORM, 1987-1992



points of market share as the relational and distributed DBMS vendors grow. DEC itself will be a leading player in its market but will not dominate like IBM does.

IV IDEAL DISTRIBUTED/RELATIONAL DBMS OF THE FUTURE

IV IDEAL DISTRIBUTED/RELATIONAL DBMS OF THE FUTURE

- INPUT used the questionnaire in Appendix A, a literature search, and internal discussion to develop the ideal distributed relational data base management system product characteristics. These characteristics, if available, should satisfy any and all applications that users have mentioned or may be contemplating.

- In addition to product characteristics, INPUT will present business criteria. These made up the bulk of the "buy" decision. While there is no company that currently satisfies these characteristics, there are some that are closer than others.

- If users were not encumbered by previous business associations and had total freedom to choose, there could be some real surprises as to which companies would be the market leaders in the five-year planning horizon. Understandably, the computer industry cannot be placed in a pristine environment for every product each year.

A. BUSINESS CRITERIA

- In evaluating a product capability as critical to the corporate success as is DBMS, it is no wonder that business criteria are very important. Exhibit IV-1 describes key elements that should be considered in evaluating the company providing the DBMS product.

EXHIBIT IV-1

BUSINESS CRITERIA FOR DBMS VENDOR

- Corporate Factors
  - Capitalization, Revenue Level, Profitability
  - Product Maturity
- Support Organization
  - Customer Satisfaction
  - Documentation
  - Training
  - Consulting
  - Maintenance Plans
- Standards Compliance
- Migration Strategy

- These business criteria are not "motherhood and apple pie" statements but rather a means to evaluate the ability of the vendor to meet the requisite needs of its customers.

- These business parameters unfortunately may tend to rule out emerging vendors from a good number of competitive situations. However, INPUT's experience is that those companies that get excellent marks in the business criteria of the evaluation are more than likely to have a serious shortfall in the product-related criteria and vice versa.

  - This is due in large measure to trying to protect the large installed base.

  - Emerging companies tend to be more responsive.

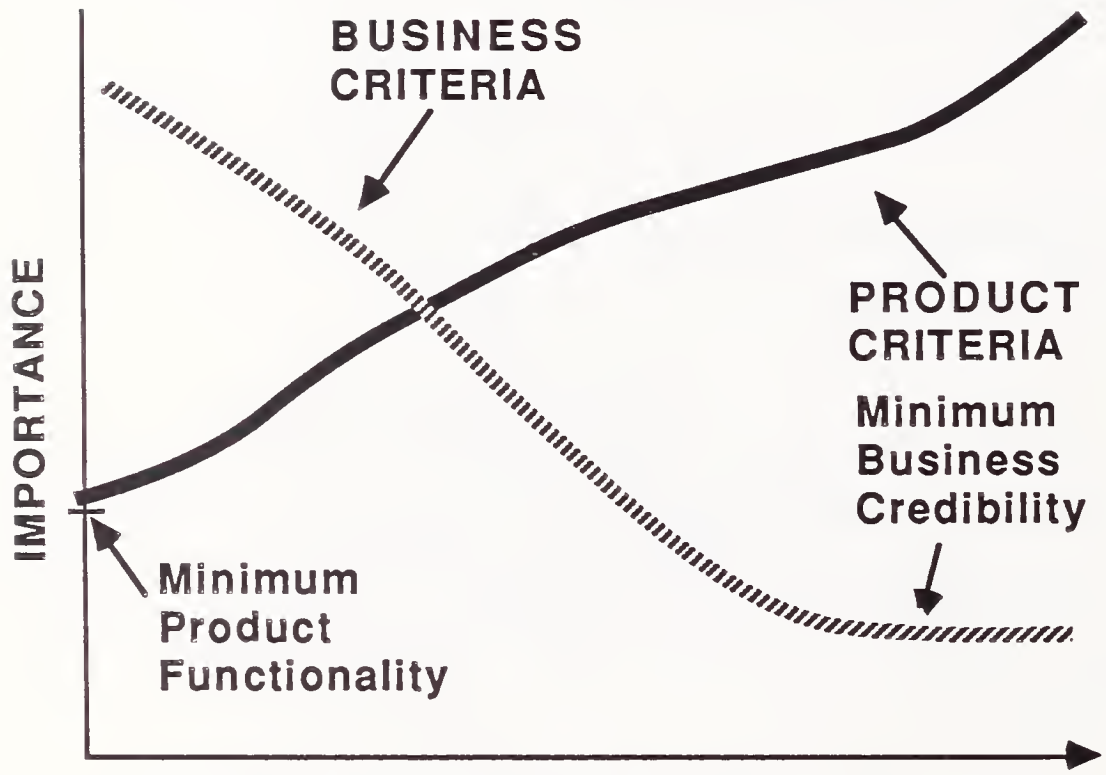
- Thus, if the user's business need is urgent because it saves a great deal of expense and provides a strategic or competitive advantage, it is likely the end user will seriously consider the business criteria limitations and engage the vendor anyway. After all, if this was not the case, there would be few new and successful companies.

- It is INPUT's belief that business criteria are most serious considerations when the situation concerns the corporate commitment or corporate data and becomes less important as the application requirement platform becomes smaller or the application becomes less general or more specific to the corporation. This means that departmental/minicomputer-based applications (if part of a larger environment) or micro environment procurement will weigh the business criteria with less importance.

- Exhibit IV-2 shows a graph depicting the business criteria and product criteria in terms of buying characteristics as related to company size and/or application specifics.

EXHIBIT IV-2

BUYING CHARACTERISTICS



COMPANY SIZE/APPLICATION IMPACT

Large Company	Medium Company/ Large Company Division	Small Company/ Small Group
Mainframe	Departmental/Mini	Micro
Important Global Application	Specific Application	Highly Unique Application/ Personal Use of Data

- Standards compliance is an important issue, irrespective of company size because it expresses a philosophy or culture to be consistent with the rest of the world. There are a couple of standards that have emerged that are particularly useful to consider.

  - The ANSI SQL standard.

  - Network standards or popular de facto standards like SNA.

B. PRODUCT CHARACTERISTICS

- Exhibit IV-3 lists the major product characteristics that will be required to functionally satisfy the user community. They are listed in the order of importance. There is no data base management product currently being offered that entirely satisfies the list presented.

- INPUT believes that the order of the items in the list may change a little over time based on effective marketing and promotion. For example, everyone wants a relational DBMS because it is good for you. Everyone is telling you, i.e., the press, consultants, advertisements, and press releases, that relational data bases are the future (of course, the future is now). It is likely the same phenomenon will cause the word "distributed" to become of the same importance, and in a few years everyone will be touting distributed relational DBMS merits as the only way to go.

1. RELATIONAL

- Users want to buy the future and obtain obsolescent-proof products. They also need to solve their application requirements.

EXHIBIT IV-3

FUTURE DBMS PRODUCT CHARACTERISTICS

- Relational
- SQL

- Distributed
  - -Data Transparency
  - -Update Transparency
  - -Communications Support
  - -Dictionary
- Production Performance
  - -Support On-line
  - -Support Inquiry

- Referential Integrity
- 4GL and DBMS Support Tools
- Spreadsheet Support
- Text Data Support
- Image Data Attribute
- AI/Expert Front End
- Optical Disk Support

M-SC4

- To look at DBMS and not consider the important complementary 4GL tools would not be very practical. While it is beyond the scope of this report to discuss the functional characteristics of 4GL and FGL (as INPUT has reported in the past), it is important to note that these support tools greatly impacted the recent success of relational DBMS.

- Relational DBMS technology allowed the everyday end user to have control of the application and not have to rely on the corporate programming staff to develop the application. Thus, the ease of viewing and structuring the data in conjunction with the support tools--4GL, screen formatters, data dictionaries--allowed the true end user to develop reasonably sophisticated applications.

2. SQL

- The SQL requirement is a critical requirement to allow users to easily use DBMS tools effectively. In fact, its invention as part of the research performed in the early 1970s and its initial implementation by Oracle may be key factors to the ultimate success of IBM in the DBMS market.

- The SQL is one of Codd's 12 rules and calls for the ability to interact between the supporting tools and the data base engine. If a vendor does not possess SQL support now or have an active development plan to have it in the near future, then it is not worthy of consideration as a viable vendor.

- Using 20-20 hindsight, it is clear that a number of hardware manufacturers have had significant success in the departmental systems environment. In addition, a good number of manufacturers have had success with UNIX boxes. These all have resulted in diverse use of DBMS packages in those environments and clearly these packages were not provided by IBM.

- The emergence of departmental systems, the lack of a dominant data base vendor, and the capabilities of Oracle and Relational in the VMS world and

Informix and Unify in the UNIX world gave rise to relational DBMS. Being relational meant it was implicit that an inquiry language was required. It was easy to refer to the work at either IBM or Cal Berkeley to obtain the basis of such a capability.

- Oracle built its company following the IBM technology. This meant that SQL became its query language. In fact, Oracle was the first commercial entity to market SQL capabilities.

- Relational developed QUEL based on the Cal Berkeley association. While QUEL is still available, it is not a surprise that Relational also supports SQL and, in fact, sits on the ANSI committee for SQL.

- IBM announced SQL as part of its DB2 announcement in 1983. Everyone supporting SQL and its becoming an ANSI standard means that IBM systems will have an easier time communicating with a different vendors' hardware and vice versa. SQL becomes the application bridge and the way for hardware manufacturers to easily obtain data base connectivity.

3. DISTRIBUTED/PRODUCTION-ORIENTED

- There are still some limitations with RDBMS technology that needs to be overcome. These limitations prevent relational systems from totally replacing the previous technology.

  - Production or transaction performance is essential to win the corporate applications wherein commercial transaction processing or heavy on-line applications such as airline reservations, banking, or automatic teller processing are necessary.

  - Distribution of data to better manage the corporate information. The requirement has been forecast for quite some time, but it is only recently that Relational Technology and Oracle have announced distri-

buted data base technology in terms of a product release. Others are in development but are not likely to surface before 1988. Exhibits IV-4 and IV-5, courtesy of Relational Technology, show distributed data base concepts in a pictorial manner. Sybase also supports distributed data base capabilities.

- A relatively new company (it actually was founded in 1984 but has been in the developmental stage), Sybase has developed its software to address the limitations of current relational systems. Exhibit IV-6 describes the application environment for RDBMS into decision support and on-line applications. The current RDBMS vendors do an excellent job of meeting the needs of the decision support applications.

- It is generally regarded that the current RDBMS are not able to sustain multiple user use or high transaction rates for production-oriented applications. This requirement gave basis for the hardware-assist DBMS vendors such as Britton-Lee, Teradata, and Accel. Sybase believes it can solve the bulk of this problem through its software on nonproprietary hardware.

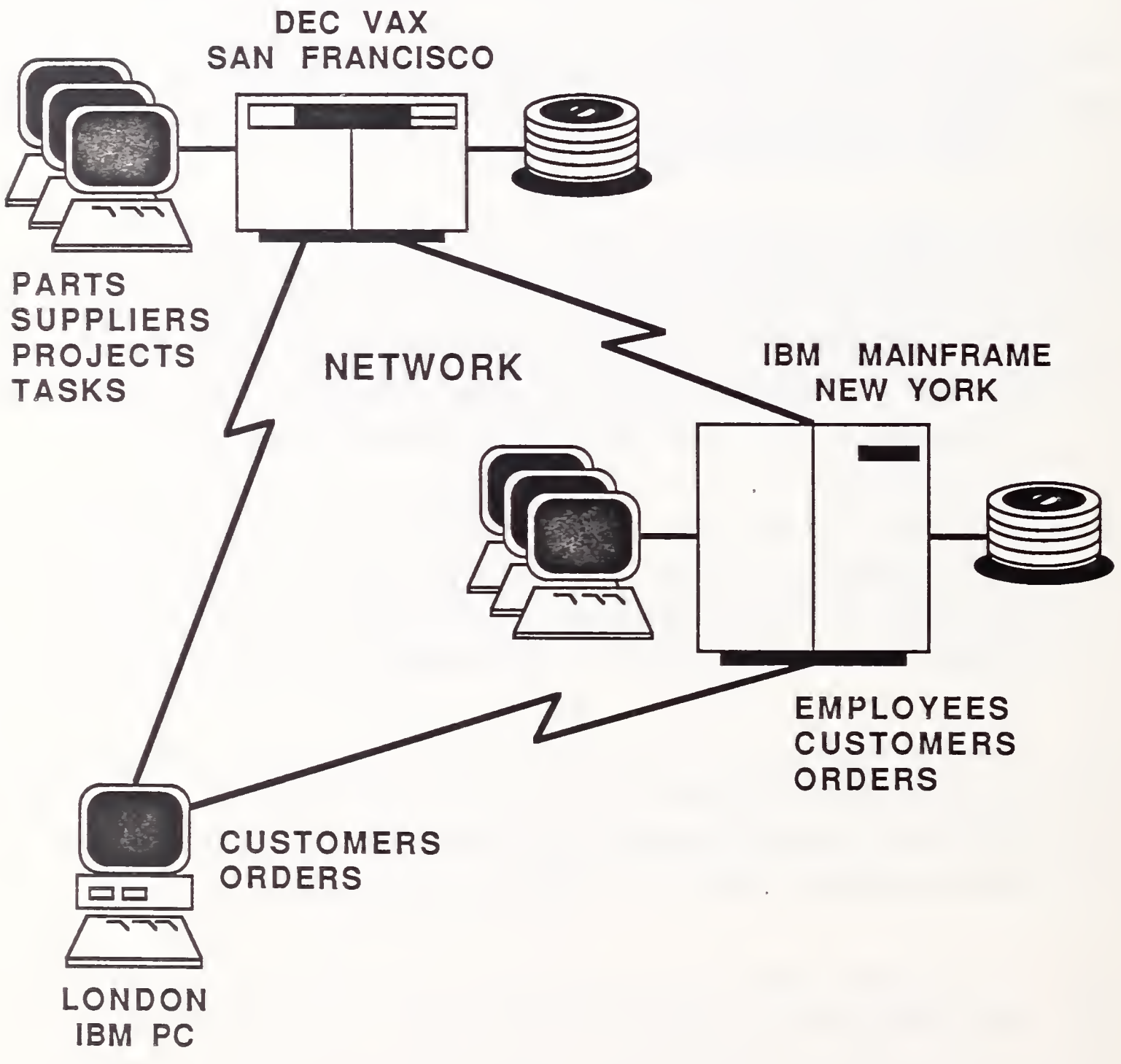
- Distributed data base concepts are being promoted as a means to more effectively manage the data/information/knowledge (D/I/K) of the corporation. The local pieces of the data are made available to the local users, cognizant that "distant" users can have effective access to data they require when necessary.

- These concepts provide for load balancing, storage balancing, and mechanisms to more efficiently communicate whether it is for inquiry or update purposes. Underlying network technology using IBM's LU6.2 and/or DECNET holds the promise of bandwidth and communications support for DRDBMS.

- An important factor in the distribution of data is the requirement for a global data dictionary to manage the data definitions. It is likely that two types of directories are necessary--one that is primary for global use and the second which is local- and tool-specific. There must be a mechanism to communicate between the two directories, and SQL is the suggested candidate.

EXHIBIT IV-4

USER VIEW OF DISTRIBUTED ACCESS

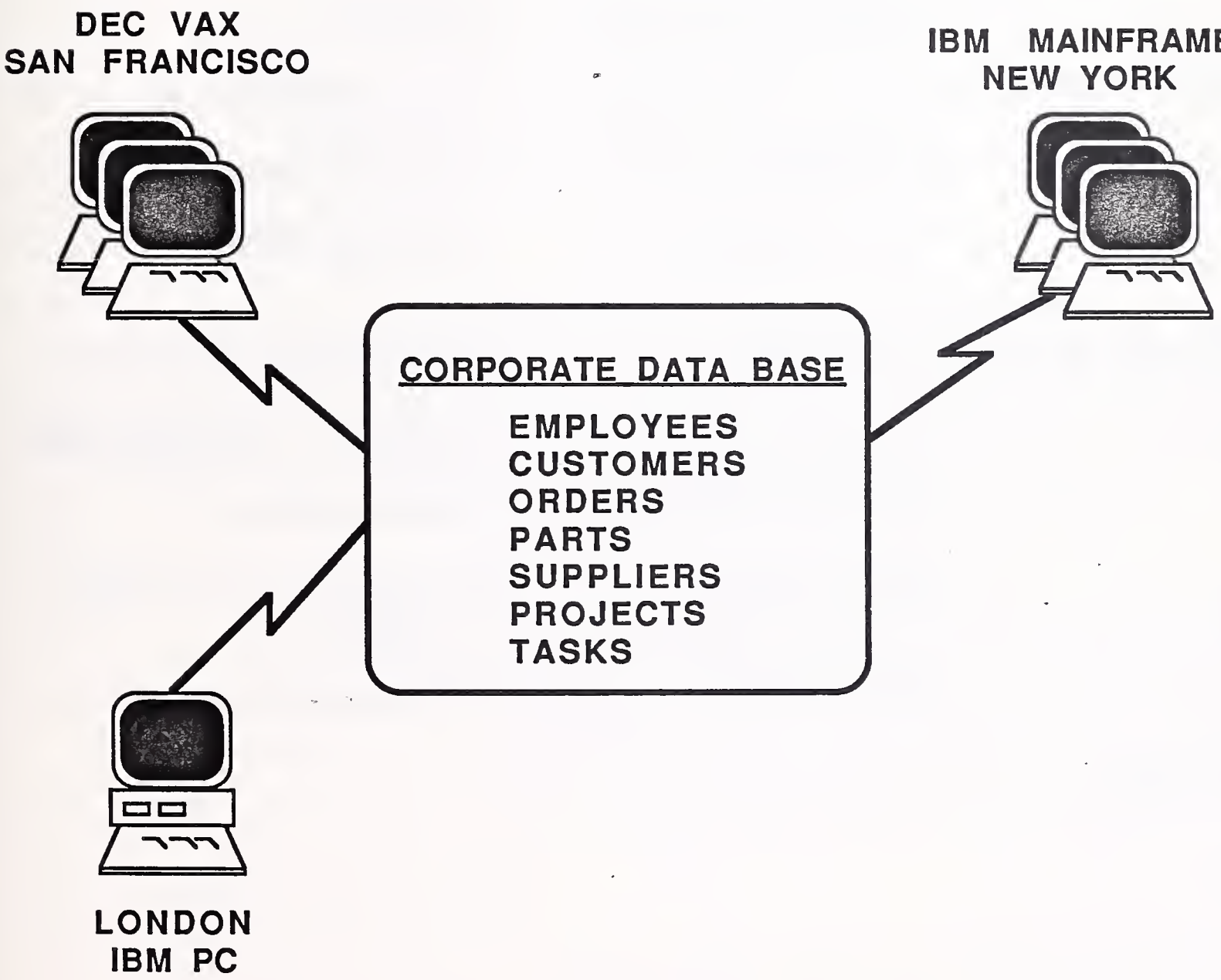


Courtesy of Relational Technology

MCC4

EXHIBIT IV-5

USER VIEW OF DISTRIBUTED DATA BASE



Courtesy of Relational Technology

EXHIBIT IV-6

TYPICAL APPLICATION ENVIRONMENTS

	DECISION SUPPORT	ON-LINE
Application Type:	Inquiry and Analysis	Transaction Oriented
	Retrieval Intensive	Update Intensive
	Ad Hoc Queries	Predefined Queries
User Environment:	< Ten Users	Tens to Hundreds of Users
	DB Size < 300 MB	> 300 MB— Multi-gigabytes
	Downtime Acceptable	High Availability
	Performance - Complex Queries	Performance - Transaction Throughput
	Single Machine	Networked Environment

Courtesy of Sybase

- It is INPUT's view that DRDBMS technology holds a great deal of promise for the corporate environment, allowing dispersed computer resources to be assimilated in a natural fashion.

  - The underlying data base technology has been in the research labs for some time and seems ready to surface.

  - The underlying communications technology is in a similar state of readiness with most of the vendors ready to implement IBM's application program-to-program communications protocol (i.e., LU6.2). The hardware vendors have all announced support, and companies like Communication Solutions (San Jose, CA) and System Strategies (New York, NY) are making a business marketing the communications protocol technology.

- What needs to take place is a couple of showcase implementations that prove the effectiveness of distributing the corporate data. Again, the sale is not one of the technology but one more of culture, procedure, and cost-effectiveness. INPUT believes the 1988 through 1990 timeframe will see a significant and growing number of corporate IS managers opting for this strategy.

- The economies of distributing the data to smaller platforms is compelling when the IS manager evaluates the MIPS required to do the application and how to best solve the overall problem. INPUT is aware of several very large customers who are well into the execution of this strategy but are not willing to disclose at this time for fear of losing their competitive advantage.

4. REFERENTIAL INTEGRITY

- Referential integrity is covered by several rules in Dr. Codd's 12 rules for a relational data base. Referential integrity is an important feature because it ensures that there is a means of providing data integrity and validity and controlling the relationship of the data.

- It is noteworthy that IBM's DB2 does not have a data dictionary or referential integrity. In fact, the announcement of a new DB2 release in June 1987 does not contain referential integrity or data dictionary functionality. Instead, IBM announced DBRAD which amounts to nothing more than catalog extensions.

- Serious users of RDBMS products are desirous of obtaining referential integrity and a data dictionary to ensure that applications do not have to build in the data relationships and business rules for the corporation.

  - Fundamentally, the data base administrator would be prohibited from deleting data from one table that was needed in conjunction with information in another table. Similarly, if information was deleted from a "parents" file, it would be enforced against a "dependents" file as well.

  - Business rules, which are an added concept of some DBMS vendors makes possible the coding of the way the corporation does business, i.e., procedures specific to the corporation to be implemented at the central source. This will be invaluable to not only controlling the data values, types, and relationships but also the way the data interacts at the business level.

5. 4GL AND DBMS SUPPORT TOOLS

- These products are integral to supporting the RDBMS in being effectively used. Every RDBMS vendor has a reasonably good set of supporting tools except for IBM. This, however, has not been detrimental to IBM as some of the independents do an exceptional job of supporting DB2 through their tools.

  - Several vendors can read/write DB2 formats and IMS formats, effectively providing a transition strategy for users to migrate from IMS to DB2. IBM itself has no elegant tool to perform the transition.

- DB2 will become its own market as 4GL and support tools that were previously captive to a particular DBMS (usually the vendor's own) will be enhanced to support DB2. This will enhance the vendor's sales opportunity to market its own DBMS because it can offer protection against a customer's feeling of being locked out of DB2 by choosing an independent vendor today.

6. SPREADSHEET SUPPORT

- This feature allows the DBMS data to be moved into a spreadsheet format to be analysed in the context of traditional spreadsheet applications. Most vendors provide a mechanism for downloading the data to a PC and placing it into Lotus 1-2-3 format as part of the process.

- Some vendors have a fairly powerful decision support tool inherent in their 4GL, e.g., D&B Computing or Focus or a standalone program like FOCCALC (from IBI), that precludes the requirement to support an "external" spreadsheet.

7. TEXT DATA ATTRIBUTE

- In addition to the current growth of DBMS applications, there has been a rampant growth of applications that provide for enhanced quality of documents incorporating graphics, multiple fonts, and point sizes.

- It is believed that the storing and cataloging of these documents will become a useful application in the next few years. Of the vendors polled, very few were embarking on any specific developments to handle these compound documents. Most felt their current data base architecture would have little difficulty in supporting document management and retrieval.

- Since the vendors are market-driven and their customers were not explicitly requesting this requirement, the vendors were not particularly concerned. They have enough to do to handle the first six points mentioned above.

- It is useful to note that Wang has introduced the Wang Integrated Image System (WIIS) to provide document management capabilities. WIIS incorporates digital scanners, image workstations, and optical storage systems. Users will be able to scan, store, and combine portions of a document and display them on a single workstation.

- Henco Software (Waltham, MA) has supplied a DBMS for text management applications. DEC has recently signed a cooperative marketing agreement with Henco to co-market to the legal industry.

8. IMAGE DATA ATTRIBUTE

- There has been an increase in the number of computer systems supporting scanners. This puts documents in a bit map form and allows for line art and pictures to be input to a computer. Similar to text data, the majority of vendors have not had many end-user requests to provide this capability.

- INPUT believes the ability to handle text data and image data will become most useful and required in the last third of the planning horizon for this report. Therefore, it is not surprising that vendors have not made definitive plans to include these useful new attributes at this time.

  - Many of the older, more mature DBMS vendors are running their R&D programs hard to supply the initial six items in the DRDBMS functionality list. These vendors tend to be grouped on the East Coast. Some are still working hard at having SQL support.

  - The technological leader vendors, i.e., those on the West Coast are working hard at distributed data base technology and/or transaction processing throughput enhancements. Clearly, these have a bigger payback.

- INPUT believes that there will be niche vendors that will initially attempt to satisfy the first user's requirements to support image data. An example would be Executive Technologies (Birmingham, AL) which has a PC-based full-text search and retrieval program that incorporates graphic images.

- Also the new Wang Integrated Image Sysstem (WIIS) mentioned in the previous section will support the same application with image attributes.

- INPUT believes that some vendors will develop constructs that will allow their users to have user-defined data types that would be able to solve the image and/or text attributes as well as others that may be unique to their environment.

9. AI/EXPERT FRONT-END

- DRDBMS vendors will develop strategic partnerships with knowledge-based expert system vendors to facilitate a more productive development and applications usage environment. The ability to generate SQL bridges through the expert systems approach is being developed by:

- AION Corporation (Palo Alto, CA), which has developed a knowledge base to facilitate intelligent applications using SQL to bridge the DBMS data engine.

- IntelliCorp (Mountain View, CA), which is linking SQL data base engines on VAXs with KEE-based knowledge processing applications. The KEE connection links SQL relational data base (currently Oracle, Relational, and Britton-Lee data base machines with support for DB2 in the future) with IntelliScope. IntelliScope provides an environment to query, browse through, and analyze the data stored in the DRDBMS.

- Artificial Intelligence Corporation (Waltham, MA), which interfaces Intellect to DB2 and Focus. AI allows users to create and update DB2 tables, build forms, and request reports using plain English. It also makes the use of SQL transparent to the user.

- In the research labs at Cal Berkeley, "Postgres" is being developed which will have a significant interaction with a knowledge system.

10. OPTICAL DISK SUPPORT

- INPUT has written previously about the growth of optical disk products over the five-year planning horizon. While there are some important technological constraints, i.e., write once, it is INPUT's belief that these will be solved.

- This will make optical disks an important large-scale storage medium and help drive the cost/megabyte of data down to a new low. This will allow much more storage to be kept on-line due to the economical justification point being considerably lower.

- Most of the vendors contacted were not actively looking at this potential requirement. It was their consensus that optical disk storage devices were still more distant than some of the more pressing developments on the R&D plate, and there was little payoff in activating a research program to handle this potential requirement. Besides, it was almost everyone's initial belief that the addressing and managing of optical storage was more an operating systems problem than a DBMS problem. In other words, when the operating system is able to support multiple writable optical media they would be in a position to easily support these devices.

- It is INPUT's opinion that there will be more to this area than one sees at first glance (like the tip of an iceberg) and that there will be an opportunity to differentiate from the rest of the DBMS pack by truly investigating this area.

- In summary, the product characteristics presented above are ones the serious DBMS supplier will have to reckon with to be a viable supplier in the next five years. By providing these product characteristics across the micro, mini/departmental, and mainframe platform/environments, the vendor can ensure that all applications in the foreseeable future can be addressed. In fact, the ability to have the same data base product(s), i.e., data base engine, integrated support tools, user interface, dictionary, etc., over all platforms truly raises another characteristic that is more implicit rather than explicit.

- This characteristic has to do with the "portable" nature of the DRDBMS software environment to other platforms, operating systems, and computing environments. Being as ubiquitous as possible in a timely fashion will be a overall factor (part business, part product) in a vendor's success. There is no doubt in INPUT's view that DRDBMS vendors will become the application underpinning for almost all applications being developed now and in the future, replacing the generalized file access methods available through programming languages.

V COMPANY PROFILES

V COMPANY PROFILES

- This section contains profiles on 10 companies that are major participants in the DBMS market either through sheer size, technological leadership, or special market influence. Exhibit V-1 lists the companies profiled and places them in one of six categories:

  - The "leader."
  - Technology "leader."
  - Micro "leader."
  - Follower.
  - Tools.
  - Emerging.

- Exhibit V-1 also indicates the predominant environment(s) the vendors' products operate in.

- The ten vendors selected (except for IBM) will be discussed in terms of some general background information, financial information, recent events, and its strategies and analysis.

EXHIBIT V-1

COMPANIES PROFILED

COMPANY	CATEGORY	PREDOMINANT ENVIRONMENTS
IBM	THE "LEADER"	Mainframe
Cullinet	Follower	Mainframe
ADR	Follower	Mainframe
Cincom	Follower	Mainframe
Oracle*	Technology Leader	Mini/Micro/Main
Relational*	Technology Leader	Mini/Micro/Main
Informix	Technology Leader	Mini/Micro/Main
Ashton-Tate	Micro "Leader"	Micro
Sybase**	Emerging	Mini (On-Line)
Information Builders	Tools	Main/Micro/Mini

*Released first phase of a Distributed RDBMS Strategy (1986)
**Recently announced On-Line Oriented Distributed DBMS

- It should be obvious that there are far too many firms in the DBMS arena, so it is nearly impossible to analyze each and every firm.

- The companies chosen each have a specific reason for being selected as follows:

  - IBM, because it is the largest and its developments have an indelible effect on the DBMS market, e.g., relational concepts and SQL themselves.

  - Applied Data Research, Cullinet, and Cincom because they are the three largest mainframe vendors that have gone toe-to-toe with IBM in pursuing the IBM mainframe market and are now "following."

  - Oracle, Relational Technology, and Informix because they are the three technology leaders with Oracle and RTI pushing the technology in almost every platform and technology and Informix the leader in the UNIX environment.

  - Ashton-Tate because it is the leader in the micro environment.

  - Information Builders (Focus) because it is the leader in providing tools and DBMS connectivity as well as its own DBMS capabilities.

  - Sybase because it is an emerging company focusing on on-line data base applications providing high availability, transaction orientation, and performance capability.

- The term "follower" in the exhibit is meant as a non-negative term to express the fact that these companies have been perceived as making advances and improvements later than the leaders. Unfortunately, the followers (who once were leaders themselves) have the near impossible task of maintaining order in their installed base while they transition to new technology. The term

"follower" is probably nicer than some other references to the "born-again" label.

- There is no doubt that new companies have a decided advantage in that whatever they produce (at least the first time) has the luxury of no impact on an existing installed base.

A. IBM

1. GENERAL ASSESSMENT

- As in any computer submarket, IBM is a factor merely by its existence. In the DBMS/application development market, IBM has announced its strategic importance. This generally equates with account control. The bottom line is that IBM has told the world it is serious about its activities in this important application market.

- This seriousness has manifested itself in several ways:

  - IBM has had an aggressive release schedule and been making a special effort to keep its customers informed.

  - IBM has had aggressive pricing for its DB2 product providing six months free evaluation in 1986 (essentially to promote DB2), and introducing special pricing for the initial DB2 license in February 1987.

  - IBM has participated in industry forums and/or user group meetings providing product enhancement, insight, and direction.

  - IBM has informed its customers and the consulting community that DB2 is the new important product but that IMS will still be enhanced for quite some time to come.

- In spite of this seriousness, there are several major shortfalls that provide an ample opportunity to sell against IBM. These are covered in the next section.

2. DB2 SHORTFALLS

a. Lack of Functionality

- IBM is missing several important capabilities that have been mentioned in Chapter IV.

  - There is no integrated data dictionary to allow the data base, data base support tools, and application environment to interact. There has been a development program called the Global Repository project internal to IBM which seems to have run into laboratory ownership problems.

    . The project is to provide a "super" data dictionary to encompass the IBM world, i.e., DB2, data design tools, networking, TSO, etc.

    . The project had been under development for three years in Poughkeepsie (NY) and has been moved to Santa Teresa (CA).

    . The DB2 customer needs a complete dictionary function for DB2 as well as for application development and fourth generation languages.

  - Referential integrity is not available, thereby placing a more significant burden on the individual application programs to develop the appropriate mechanisms to handle this need and place more reliance on human awareness.

    . It is expected that IBM will provide referential integrity after the first release of a reasonable data dictionary.

b. Distributed Data Base Too Far Out

- There is no distributed capability on the horizon. A recent IBM spokeswoman related distributed functionality as described in this report to be at least two years away. And that was just to have the communication building blocks to provide the distributed data base capability.

  - Some of the building blocks are LU6.2 support for the Enhanced Connectivity Facility (ECF), Distributed Data Management (DDM) file access in ECF, and implementations of SQL support for System 3X and IBM PC/2.

  - It is not clear how IBM supports other computer systems hardware. This is a general problem for most hardware vendors which is partially solved by ANSI SQL support.

c. Weak Applications Development Tools

- There is a significant lack of capability in the area of integrated application development support.

  - As one industry consultant put it, "Still, development tools are not IBM's thing. IMS tools never really became wonderful."

  - Cross System Product (CSP) does not measure up to any of the independent 4GLs in the market.

  - This shortcoming is a market opportunity for the independent vendors who can complement DB2 with their sophisticated tools, i.e., DB2 becomes its own market.

  - Some vendors are supporting or will support IMS as well. Vendors in this category are Software AG, Information Builders, D&B Computing, Cincom, Cullinet, and Applied Data Research to name a few.

- Supporting IBM's DB2 or IMS is a double-edged sword.

  . On one edge it detracts from the total systems value of the independent.

  . On the other edge it provides a comfort feeling that the user can easily drive their applications to the vendor-specific data base engine or to the IBM data base engine.

d. Lack of Performance

- The performance characteristics of IMS through the specialized Fastpath and TPF are not going to be supported by Systems Application Architecture (SAA). DB2 is targeted for support in SAA. The performance of DB2 has been lackluster. IBM acknowledges that its initial design goals for DB2 are to provide significant flexibility and high functionality.

- Improvements to DB2 to enhance performance will be incremental on the order of 10-20% with each release. IBM does not expect large performance improvements in the next couple of years.

- For all these reasons IBM is somewhat vulnerable in the near term. Yet, in spite of the above, IBM has made significant inroads in getting customers to license DB2.

3. DB2 STRENGTHS

- IBM announced DB2 as its relational DBMS with the belief that no one DBMS can satisfy all users' requirements.

- DB2 was lambasted by the competition for being part of a "dual strategy" causing confusion for the customer. By definition the announcement of DB2 caused problems for the vendors in the mainframe environment because all

their customers and prospects would have to do an evaluation to assess the value of DB2. This negatively impacts the independent in the sales cycle and seriously delays action.

- INPUT believes DB2 will be a significant factor in the relational DBMS market and will garner 60% of said market by 1992.

- DB2 has some functionality shortfalls, but these will be rectified.

- DB2 will be used as the application underpinnings by all the major application vendors, e.g., MSA, McCormack & Dodge, Integral systems, etc.

- Using 20-20 hindsight, INPUT believes the announcement and release of DB2 was a masterful stroke of marketing on the part of IBM.

  - It announced a new product meeting a current marketplace requirement in terms of being leading edge.

  - It retained the existing IMS installed base, yet provided a vehicle for new applications.

  - It segregated the old from the new, giving DB2 its own unique personality.

  - It stalled the growth rate and penetration of the independents.

  - It bought time to develop the product and ease its customers to the new "promised" land.

  - It sold more hardware/software by virtue of the inherent requirement to migrate the user to a more featured operating system and memory system to support the MIPS required of DB2.

- To be most effective with DB2, IBM recommends that the user upgrade to MVS/XA.

- To dabble in DB2, the user will most likely need additional DASD to support the trial applications.

- To convert a live IMS application, most users use a multiple of three to transition the storage need for the new application.

- Another DB2 strength is its pricing, as described in the next section.

4. DB2 PRICING

- IBM has been very aggressive with its pricing policies for DB2. DB2 is currently offered on a monthly license cost (MLC) basis after a small initial license cost (ILC). For the DB2 applications environment the user pays an initial investment of $34,010 with an annual charge of almost $60,000. Program support adds another $6,000 per year.

- The typical mainframe competitor has a fully paid-up license approach which ranges from $150,000 to $400,000. The crossover point (without a rate of return consideration) is typically from 2.5 to 3.5 years. Since the independent typically has a higher program support charge, the timeframe for breakeven is actually longer.

- Fundamentally, the IBM pricing is a rental strategy versus the purchase strategy of the independents. Clearly, IBM can economically maintain this marketing posture much like the hardware rental strategy of the last decade. When profitability pressure occurs (such as the recent several quarters) IBM could elect to offer a purchase credit option to effect a switch to a fully paid-up license.

- The current pricing strategy has definitely impacted the independents who are virtually helpless to follow the IBM pricing structure. There is too much pressure on sustaining the current revenue levels (not to mention the desired growth) to support the corporate infrastructure.

- The exception to this is Applied Data Research who has effected a leasing strategy plan. ADR is uniquely positioned to model the IBM pricing being a subsidiary of a multi-billion dollar corporation (Ameritech) and insulated from quarter-to-quarter revenue performance and/or profitability (so they say).

- It is INPUT's belief that IBM will be forced to transition its leasing pricing structure to one of a purchasing strategy. There is no immediate need to effect such a transition until it has gained considerable market share, and the most important need is to pull some revenue out of the magician's hat.

5. IMS CONTINUES

- While the bulk of the comments in this report have focused on DB2 as the strategic workhorse of the future, one should not overlook IMS completely.

- IBM has taken considerable time and effort to let its customer base and consultant followers know that IMS is and will be around for the foreseeable future.

- It is reputed that IBM is spending as much R&D dollars on enhancing IMS as it is in developing the needed functionality for DB2. This is not viewed as an insignificant activity.

- There are some 6,000 IMS licenses all getting productive use out of IMS functionality. In fact, there are some new IMS licenses being sold based on the installed base needing another CPU to expand the existing applications base.

- IBM is attempting to get the performance of IMS up to 4,000 transactions/second by 1990. It is also making significant improvements for DB2 as mentioned previously.

- INPUT believes that some time in the next few years IBM will offer enticements to have users port smaller IMS applications to DB2. There are many applications written in IMS that would not be cost-effective to port to DB2. The IBM dual strategy is likely to exist through the end of the decade. While a number of vendors chastized IBM for this strategy, it is interesting to note that some of the hecklers have themselves announced a similar strategy, i.e., a completely new RDBMS to complement the existing hierarchical DBMS product.

6. STRATEGIC RELATIONSHIPS

- In order for IBM to support the non-IBM platform environments, it will need to enter into strategic relationships with the leading independents and/or others that can support this requirement.

- In fact, the recent Lotus/IBM announcement suggests that IBM will enter into arrangements for even its own hardware platforms, although the PC has always been a special case.

- INPUT does not believe IBM, DEC, or any of the other computer system manufacturers will get into the business of porting or developing software for foreign platforms.

B. CULLINET

1. BACKGROUND

- Cullinet has been a participant in the DBMS arena since the early 1970s. It had considerable success with IDMS through the early 1980s and topped $184 million in revenues in 1985. It missed the opportunity to take advantage of its independent leadership position to migrate its software to other platforms and missed the chance to come out with a true relational DBMS to counter the new players touting relational DBMS. Cullinet has been making a concerted effort to rectify its DBMS strategy while embarking on a strategy to diversify by acquiring a number of application products in manufacturing, general ledger, human resources, and banking.

- Unfortunately, the vertical diversification strategy gains have been more than offset by loss of revenue in the native DBMS environment. This situation is largely due to the recent aggressive marketing policies of IBM in releasing its pure bred relational DB2.

  - Cullinet's DBMS is IDMS/R, ULTRA on VAX/VMS.

  - Cullinet's 4GL is IDMS/R (1985).

2. FINANCIALS

- Cullinet is a public company. Its revenue for the past three years was (fiscal year 4/30):

  - 1987 - $145 million (estimate).

  - 1986 - $184.3 million.

- 1985 - $184.1 million.

- 1984 - $120 million.

- International sales represent approximately 15%.

3. RECENT EVENTS

- Cullinet has been making acquisitions to shore up its business lines. The key ones made in the past year are:

  - ESVEL (July 1986) for $8.4 million. This company was founded by former employees of IBM (San Jose, CA) to develop products for the DEC VAX and micro arena. This acquisition will be the basis for IDMS/D which has been rumored to be a deliverable in late summer 1987.

  - Distributed Management Systems (February 1987) for $18 million offering distribution management software. Speculation suggests that some of the recent activities at DMS were in expert systems which somehow could provide a competitive advantage if effectively integrated into IDMS/D.

- Several early players who helped grow the company in the 1970s, were William Casey, Ronald McKinney, and Jon Nackerud (who was a founder and first president of Relational Technology). To this add John Landy from the DMS acquisition who had been a key player at McCormack & Dodge.

4. STRATEGY AND ANALYSIS

- Cullinet has not had the best of times lately, and a major change in senior management has occurred as well as bringing back some earlier people who contributed to the prior period of success. Since people are a very important factor; this is a strong basis to not rule Cullinet out.

- The introduction of the VAX/VMS IDMS/D (the current IBM mainframe product is known as IDMS/R) based on true relational underpinnings and the porting to the 9370 could get Cullinet back in the market as a respected RDBMS vendor. However, there seems to be no strategy for the PC/micro environment nor one for UNIX. These could be major oversights, although Cullinet did forecast a PC product with no timetable.

  - A possible way to overcome this shortfall would be through another acquisition. Perhaps there are some companies that are strong in the PC/micro and UNIX environments who may have tough times ahead in breaking into the IBM mainframe environment.

  - However, the last thing in the world Cullinet needs is another acquisition to assimilate into the company.

- The IDMS/D and IDMS/R could be viewed as a dual DBMS marketing thrust. It was not too long ago that Cullinet was expressing its concerns over the confusion IBM brought to the market with its introduction of DB2.

- Cullinet has also forecasted its intention to offer distributed data base technology. This would make the most sense after it has DBMS software running on more platforms.

- The recent events have promise for Cullinet, and the next year will be one to watch. Assimilating the numerous acquisitions, obtaining synergy from the diverse functional areas, and turning around revenue and profitability are quite a challenge.

C. APPLIED DATA RESEARCH (a subsidiary of Ameritech)

1. BACKGROUND

- Applied Data Research (ADR) was founded in 1960. It introduced DATACOM/DB in 1974 and had considerable success. It introduced IDEAL, a 4GL, in 1982 and it was successful. ADR ran into the same difficulties as Cullinet and Cincom in the IBM mainframe market over the past couple of years. Ameritech's acquisition of ADR provides deep pockets for investing in the future. It should be no surprise that ADR was having problems at the time of the acquisition.

2. FINANCIALS

- Applied Data Research was a public company at the time of its acquisition by Ameritech. Ameritech, one of the regional Bell Operating Companies created by the divestiture of AT&T, chooses not to disclose specific results of its subsidiaries. Based on INPUT's estimates and public information, the revenue for the past three years was (fiscal 12/31):
  - 1986 - $145 million (INPUT estimate).
  - 1985 - $150 million.
  - 1984 - $128 million.
- International sales represent 13% of ADR's revenue.

3. RECENT EVENTS

- ADR acquired the rights to XDL from Software Systems Technology (College Park, MD).

- XDB is a PC-based RDBMS and has incorporated SQL into it. ADR will use the SQL technology to enhance its mainframe products.

- SST's president is Dr. S. Bing Yao, a professor at the University of Maryland, who has been doing research on SQL query optimization.

- ADR committed last autumn to a PC RDBMS and local area network support.

  - IDEAL Escort, a PC version of IDEAL, is in beta test and will be released in June.

  - XDB needs to be repackaged to be introduced in the market.

- 3M signed a contract worth up to $7 million to use ADR's DATACOM/DB.

- Triad Systems, a leading turnkey vendor, contracted for ADR's products for the IBM 9370-based product Triad will be introducing to the automotive market.

4. STRATEGIES AND ANALYSIS

- ADR has expressed that its overall strategy will be to ". . .take IBM head-on. Some of our competitors, like Cullinet, have a different strategy--diversification--but we have chosen to stand and fight."

  - These words from ADR's President Dennis Strigl echo in two ways:

    - Mr. Strigl is from Ameritech, the RBOC that spent $215 million to acquire ADR in 1986. This shows Ameritech's desire to impart its influence on ADR directions. It also has expressed its willingness to invest in ADR's business and take the Wall Street green eyeshade view off the company.

- ADR believes it can continue to make inroads against IBM once the data base marketing scenario returns to normal. IBM's strategic product announcement for DB2 and some excellent marketing has stymied all the mainframe DBMS vendors.

- ADR is acknowledging that even though it is going toe-to-toe with IBM, the DB2 in itself represents a market opportunity for supporting tools. Therefore, it will modify IDEAL, its 4GL, to support DB2 for 1988 availability. This will allow ADR to sell IDEAL to DB2 users, get its foot in the door, and obtain recognition for DATACOM/DB.

  - ADR has just gone through an excruciating benchmark against DB2 on the West Coast and beat DB2 "hands down."

  - This strategy should provide a feeling of comfort to the DATACOM/DB users that they could easily switch to DB2 if they were technically forced to by IBM.

D. CINCOM

1. BACKGROUND

- Cincom has been supplying DBMS systems for over 17 years. TOTAL, which has a large installed base, was a competitive product to IMS. Cincom has spent considerable R&D dollars over the last several years; one company source indicated $100 million over the past seven years. Cincom must spend an incredible percent of its annual revenue on R&D.

  - Cincom's RDBMS on IBM mainframes is SUPRA which started shipping in September 1985; on VAX/VMS it is ULTRA (1985).

- Cincom's 4GL is MANTIS which started shipping in December 1979.

2. FINANCIALS

- Cincom is a private company. INPUT estimates that its revenue for the past three years (fiscal year 9/30) was:
  - 1986 - $104 million.
  - 1985 - $92 million.
  - 1984 - $85 million.
- Cincom has been profitable and expects revenue to be $120 million in fiscal 1987. Approximately 48% of its revenue is external to the U.S.

3. RECENT EVENTS

- Cincom entered into a cooperative marketing agreement with Ashton-Tate (June 1986) that calls for joint efforts between the companies. This relationship has been lackluster.
- SUPRA's next release as evaluated by Dr. Edgar F. Codd of the Relational Institute surpasses IBM's DB2 in "relational fidelity." This was without SQL support.
- Cincom announced new modules to be added to SUPRA to support IBM's IMS and DB2. The IMS module will be available first, followed by the DB2 module which will also include SQL support. INPUT estimates IMS support to occur in September 1987 and DB2 support first quarter 1988. Cincom suggests IBM IMS users develop MANTIS applications now and run them under SUPRA's IMS module when it is available.

4. STRATEGIES AND ANALYSIS

- Cincom seems hesitant regarding the supporting of UNIX and micro environments (they are still evaluating a PC version; perhaps the PC/2 in a better position to support a possible version of SUPRA). Not supporting UNIX could be a significant shortcoming over the very long term. INPUT further believes that Cincom is not aggressive regarding entering the distributed data base foray which may be an interesting cautious view.

- Cincom has branched out into network management and business control and may be developing alternative strategic business units to continue to weather the IBM mainframe storm. On paper, SUPRA is alleged to be superior to IBM's DB2 and supports referential integrity and a dictionary. However, the lack of SQL support could be a serious detriment to coexisting with other DBMS and platforms.

- INPUT estimates that less than 10% (approximately 250 users) have migrated to SUPRA. It is interesting to note there are no migration tools supplied to TOTAL users who must make a significant effort to convert.

- Cincom must have considerable confidence that its installed base will choose SUPRA as the migration to SUPRA, and the level of effort it requires opens the door to the IS manager to look at other alternatives.

E. ORACLE

1. BACKGROUND

- Oracle was founded in 1977 and introduced ORACLE, the first commercial SQL-based language relational DBMS in 1979. ORACLE is the leader in porting its software to different platforms. It has had sustained growth of

revenues and profits for the last five years and except for one year has more than doubled each year.

- Oracle's RDBMS is ORACLE (1979).

- Oracle's 4GL is part of the ORACLE system.

- Other support tools are SQL*STAR, a distributed RDBMS similar in scope to Relational Technology's INGRES/STAR.

2. FINANCIALS

- Oracle is a public company. Its revenue for the last three years (fiscal year 5/31) was:

  - 1987 - $125 million (estimate).

  - 1986 - $55 million.

  - 1985 - $23 million.

  - 1984 - $13 million.

- Approximately 35-40% of Oracle's revenue is international. Oracle has significant penetration and a reasonably fertile market overseas due to the lack of competition.

3. RECENT EVENTS

- Oracle announced several new products for the IBM PC market:

  - LANserver ORACLE to offer RDBMS capabilities on a LAN.

- PROFESSIONAL ORACLE to provide full mainframe functionality on the IBM PC by defeating the IBM PC 640K memory limit.

- Network Station ORACLE to permit a PC to access information in a distributed data base regardless of location.

- Oracle filed for a secondary offering of 2.3 million shares (1.5 million from the company) netting approximately $30 million. This will allow the company to continue to be aggressive in its developments and programs.

- Oracle announced an On-Line Transaction-Oriented (OLTP) DBMS for initial release in Summer 1987.

- Oracle announced an applications solution thrust and has started in Europe with General Ledger. This is the first indication of a DBMS vendor branching out into professional services and software products business sectors.

4. STRATEGIES AND ANALYSIS

- Oracle has embarked on a strategy to be a technological and market leader. The above secondary stock filing will help in a major way to support that goal.

- Oracle has an extensive commitment to support and seminars. There is almost a seminar a day somewhere in the U.S. The other vendors are hard pressed to match this effort.

- The company is trying to become established in the IBM mainframe market. This will be a tall order but of all the relatively new RDBMS vendors, it seems to have the best chance.

- The SQL strategy has been exceptionally powerful and truly cements the image of having wisdom and expertise.

- The IBM PC port of a couple of years ago put them among the leaders in fully functional RDBMS technology in the PC; others are following this lead.

- Oracle seems to be on a roll. The only questions that come up are its ability to win market share against IBM or the other mainframe independents and how well it will do in the international markets now that there is some competition (see RTI).

F. RELATIONAL TECHNOLOGY, INC. (RTI)

1. BACKGROUND

- Relational Technology, Inc. (RTI) was formed in 1980 to commercialize some research performed at Cal Berkeley. INGRES was originally released in 1981 and has some 6,000 systems installed. Relational is committed to being a technological leader and competes intensely with Oracle.

  - RTI's RDBMS is INGRES Release 5.0.

  - RTI's 4GL is INGRES/4GL (1983).

  - Other support tools are INGRES/STAR, the first commercially available distributed data base product enabling users to develop applications and access data that span a variety of computer systems as if all the information were resident on a single computer.

2. FINANCIALS

- RTI is a private company. INPUT estimates that its revenue for the past three years (fiscal year 6/30) was:

- 1987 - $45-50 million (estimate).
- 1986 - $28.1 million.
- 1985 - $17 million.
- 1984 - $8 million.

- Only 10% of RTI's revenue is international. In fiscal year 1986 there were no subsidiaries and one distributer overseas. One year later there are six subsidiaries and ten distributors. RTI expects to see a considerable improvement in international revenue.

3. RECENT EVENTS

- RTI was selected by Data General for a private label version to run in CEO.
- RTI was selected by Celerity and Pyramid for support in their computer systems.

4. STRATEGIES AND ANALYSIS

- RTI is working hard at maintaining its technological leadership in distributed RDBMS. It is committed to supporting numerous platforms and gateways via SQL to other DBMS packages such as IMS, DB2, IDMS, DATACOMM/DB, etc.
- INPUT's view is that this R&D activity provides promise and a vehicle for RTI to overcome the Oracle moving target (currently moving away from RTI). If there truly is an application opportunity to network disparate hosts/operating systems, then RTI is in an excellent position. The ability to support multi-site update, replication of data, support for IBM and compatible micros, and access to companion SQL-based systems is key to the success of this strategy.

- INPUT believes this technological leadership strategy is one significant way that RTI can distinguish/differentiate INGRES from ORACLE.

- RTI has been working with Boeing Aerospace and has received two supporting National Science Foundation grants to pursue distributed RDBMS technology.

- RTI has a relationship with Pansophic to provide an IBM mainframe version of INGRES. RTI claims to have a minimal number of IBM mainframe sites successfully using INGRES. It is too early to pass judgement on the "staying" power of INGRES in an IBM environment. INPUT believes that those DBMS vendors migrating up to the IBM mainframe environment are in for a rude awakening. The sales cycle, support requirements, and corporate resources to be successful in the IBM market tax most companies.

- RTI needs to go public or as a distant second be acquired to infuse capital into the company to have significant corporate resources to continue its aggressive and ambitious plans and still compete on the multiple fronts it has staked out.

- Finally, by its personal and geographical proximity to Cal Berkeley, RTI has access to the technology developments occurring at that prestigious institution.

  - For example, Dr. Michael Stonebraker, professor of Computer Science and Vice President/Consultant/Founder of RTI, has announced work on POSTGRES.

  - POSTGRES is a research project coupling AI/knowledge-based system concepts with a data base engine to integrate the notion of knowledge with data. This project embodies all the product characteristics discussed in Chapter IV of this report.

  - Dr. Stonebraker worked on the original developme team for INGRES.

G. INFORMIX SOFTWARE (formerly Relational Data Base Systems)

1. BACKGROUND

- Informix was started in 1980 based on a product design for Cromenco that was shelved. Informix has excelled at selling into the UNIX market where it has over 40% market share. It was the first UNIX DBMS to port its products to MS-DOS (1983). Its software has been ported to 100 micro/mini/mainframe environments.

  - Informix released Informix-SQL in early 1985 as its SQL-based RDBMS.

  - Informix-4GL (1986) is the 4GL.

  - Other support packages are C-ISAM (a B-tree access method), Informix-ESQL/C and /COBOL (to embed SQL support within the C and COBOL languages respectively), and Report/DB2 (a DB2 report writer).

2. FINANCIALS

- Informix is a public company. Its revenue over the past three years (fiscal year 12/31) was:

  - 1986 - $21.1 million.

  - 1985 - $10.6 million.

  - 1984 - $5.2 million.

- ALTOS Computer owns 22% of Informix.

3. RECENT EVENTS

- Informix announced Report/DB2 to allow users of IBM's mainframe RDBMS to develop complex reports quickly without using a conventional language approach. INPUT believes this is the first phase of a program to add more support for the IBM mainframe environment.

- Informix-Turbo is a new data base server running under UNIX System V providing fault tolerance and data protection.

- Informix Datasheet Add-In works in conjunction with Lotus 1-2-3 to allow users to create data bases and use query-by-example techniques.

- Informix was selected as the DBMS of choice for the newly announced Tandem UNIX product.

4. STRATEGIES AND ANALYSIS

- Informix has expressed the strategy of migrating to the IBM mainframe and VAX/VMS environments. Being the smallest of the three Bay Area companies requires more focus in developing new tools or migrating to different platforms.

- INPUT believes Informix will have a difficult time getting a toehold in the VAX/VMS and IBM mainframe markets. It has done immensely well in the UNIX environment and should pursue adding additional capabilities in this area.

- It should be opportunistic in entering other platforms as the corporate resources could be too diffused.

H. ASHTON-TATE

1. BACKGROUND

- Ashton-Tate is the undisputed leader in the microcomputer systems environment in DBMS software. It has sold over 1.3 million copies of the dBASE product family. The current release is dBASE III PLUS. The dBASE family is not a relational-based product family. The dBASE product family has become the standard in the home, personal use, and small office environment.

2. FINANCIALS

- Ashton-Tate is a public company. Its revenue for the past three years (fiscal year 2/28) was:

  - 1987 - $211 million.

  - 1986 - $122 million.

  - 1985 - $82 million.

- The dBASE product family accounts for approximately 60% of Ashton-Tate's revenue. Twenty-eight percent of Ashton-Tate's revenue comes from international markets.

3. RECENT EVENTS

- Ashton-Tate announced that its future release will support SQL, most likely in a version for the PC/2.

- Ashton-Tate announced acquisition of Decision Resources, a leading graphics package vendor on the PC.

- Ashton-Tate acquired the rights to SQL technology and several key people from Wordtech Systems (developer of Dbx1) in April 1987.

4. STRATEGIES AND ANALYSIS

- Ashton-Tate is embarking on a strategy to dominate the PC environment and offer a total applications capability. This strategy of DBMS, graphics, word processing, and perhaps spreadsheet will provide an enlarged product basket and allow for tools packaging.

- This strategy will provide control for the home user and/or the small business user offering an integrated office automation capability.

- Ashton-Tate needs a migration strategy to other platforms. There are over 1.3 million knowledgeable users. WordPerfect (the word processing people from Orem, UT) has demonstrated the success of this strategy porting to workstations and the VAX/VMS environment with rave reviews.

  - To be successful with this strategy, Ashton-Tate must support SQL.

  - Gateways to other DBMS formats would improve the impact of this strategy.

- Ashton-Tate filed for a secondary offering but has since withdrawn the offering.

  - With its resources an acquisition of a well regarded but resource lacking existing relational DBMS could have a significant impact.

  - A strategic relationship with an existing mainframe organization could be useful (one exists with Cincom but its effectiveness is not well understood).

- It is difficult to see how Ashton-Tate or any other micro/DBMS supplier can play in the corporate-oriented DBMS market without participating in a strategic relationship with a main player.

- The recent IBM/Lotus announcement does not bode well for Ashton-Tate. Lotus has a significant market appeal, and the coupling will be difficult to overcome. In addition, the Microsoft/Sybase relationship will put significant pressure on Ashton-Tate in the non-corporate arena.

I. SYBASE

1. BACKGROUND

- Sybase is a venture capital startup company founded in 1984. For the past couple of years it has been in the developmental stage. It is the first SQL-based RDBMS designed explicitly for on-line applications. It provides high-volume performance, DBMS enforced data integrity, high availability, distributed data management, and window-based application tools.

  - Sybase's DBMS is DataServer.

  - Sybase's 4GL is included in DataToolset.

- Senior management comes from Britton-Lee and Relational Technology.

2. FINANCIALS

- Sybase is a private company. Since the company has been in the R&D stage, there has been minimal revenue reported. INPUT estimates Sybase will have revenue in the $2.5-3.5 million range in 1987 (including front-end fees from OEMs).

3. RECENT EVENTS

- Sybase entered into an OEM agreement with Stratus Computer.
- Sybase closed an agreement with Microsoft for a PC-based RDBMS.
- Sybase has formally announced its products (May 1987).
- Sybase is supplying its products to Pyramid for a private label Pyramid product.

4. STRATEGIES AND ANALYSIS

- Sybase is filling an important need in the market for a transaction-oriented RDBMS. The established RDBMS vendors with the largest market share are working on Sybase-like functionality which has been described previously in this report (see Chapter IV) as to where DBMS vendors need to be to effectively compete in the 1990s.
- INPUT believes that 1987 is a key year for Sybase developing its viability and credibility as a vendor as required in the business criteria parameters previously mentioned.
- INPUT believes Sybase has real potential and is likely to be successful in executing its plan and strategy.

J. INFORMATION BUILDERS

1. BACKGROUND

- Information Builders introduced Focus in 1976 on Tymshare's (since acquired by McDonnell Douglas) IBM mainframe timesharing service. Gerald Cohen left Mathematica (original developer of RAMIS) to start IBI. Over the years Focus has become a well-used tool and has a large following. Focus was not originally designed as a relational DBMS but probably should lay claim to the 4GL concept--a term used to describe it in the early 1980 timeframe.

  - IBI's DBMS is Focus (1976).

  - IBI's 4GL is integrated into Focus.

2. FINANCIALS

- IBI is a private company. INPUT estimates IBI's revenue in the last three years (fiscal year 12/31) was:

  - 1986 - $95 million.

  - 1985 - $80 million.

  - 1984 - $60 million.

- The international portion of IBI's revenue is approximately 20%.

3. RECENT EVENTS

- IBI announced Focus is being ported to run under Xenix and will be available in mid-1987.

- Focus also runs on the IBM RT and was just recently released for that environment.

- Focus announced support for the Oracle DBMS engine.

4. STRATEGIES AND ANALYSIS

- IBI's recent ad describes its fundamental strategy of "Focus has hooks." Focus has executed this strategy over the years to have one of the largest user bases (more than 300,000) outside of the micro market. Exhibit V-2 shows the data bases, environments, and networks where Focus can play.

- IBI's strategy is to sell its 4GL capabilities, report writers, and tools to co-exist with the user's data base server choice. If the user happens to use the Focus data base server as well, then IBI is a complete winner.

- Focus can be used as a transition tool because it can directly access the data from the data bases and manipulate it, report it, and do spreadsheet analysis.

- IBI has an aggressive development program and is one of the few DBMS vendors to provide support for image data through PC Focus/Vision. It is also one of the few to have artificial intelligence/expert system hooks through a relationship with Artificial Intelligence Corporation's (Waltham, MA) INTELLECT.

EXHIBIT V-2

FOCUS CONNECTIVITY

DATA BASES SUPPORTED		ENVIRONMENTS	NETWORKS
DB2	ISAM	MVS/TSO	Decnet
IMS	TOTAL	VM/CMS	IBM Token Ring
VSAM	VAX/RMS	DEC/VMS	Banyan
SQL/DS	VAX/Rdb	PC/DOS	Novell
IDMS	DBMS	WANG/VS	ATT Starlan
ADABAS	VS/DMS	UNIX	IBM PC NET
MODEL 204	DIF	IMS/DC	Nestar
QSAM	LOTUS	CICS	
System 2000	FOCUS		
Oracle			

VI ISSUES, RECOMMENDATIONS, AND CONCLUSIONS

VI ISSUES, RECOMMENDATIONS, AND CONCLUSIONS

- The previous chapters of this report described the distributed and relational DBMS (DRDBMS) market and expressed the functional characteristics that users need to handle the diverse application requirements during the forecast period.

- The market sizing shows the data base applications base growing significantly based on users being able to more effectively utilize DRDBMS.

- However, there are some issues that do have an impact on the market that need to be mentioned to complete this report.

A. ISSUES

1. MARKET CONSOLIDATION/SHAKEOUT

- There are too many vendors trying to serve this exciting growth market. This is especially true in the microcomputer area. As corporate IS managers evaluate their DRDBMS needs, those vendors that do not have a multiple platform solution will not be able to compete effectively. This does not bode well for the micro DBMS vendor that has not already migrated to other platforms.

- In addition, DBMS vendors that have not embraced SQL will not be able to compete for corporate business. This relegates the majority of the micro DBMS vendors to becoming highly specialized or niche-oriented or to compete for the home market or small independent business. This is viewed as a commodity-priced market opportunity. Furthermore, it is likely to place considerable price pressure on existing leaders in this market.

2. SQL FUNCTIONALITY

- SQL will become an integral part of the DRDBMS market and a vehicle for interaction between disparate DBMS. There is a strong likelihood, like many standards, that there will not be enough functionality to sustain effective and efficient interaction.

  - A number of vendors have already expressed the intention to add enhancements to the standard agreed to by the ANSI committee.

  - It is expected that follow-on standard enhancement discussions will be required to have SQL be a useful standard.

  - The "cost" of the SQL standard will be:

    . Limited functionality.

    . Increased host code.

    . Decreased productivity.

3. UBIQUITOUS PLATFORM SUPPORT

- The true success of DRDBMS is based on the corporate IS manager's support and concurrence that distributing data and MIPS required to support the on-

line applications are an attractive, cost-effective way to provide applications solutions.

- INPUT believes this will occur and all three platform areas will participate in the DRDBMS market growth.

4. HARDWARE VENDORS/STRATEGIC PARTNERSHIPS

- There has been a significant increase in multivendor hardware environments since the introduction of departmental computer systems. Thus, it is common to see corporations having IBM mainframes, DEC VAX, and HP minis in multi-site or single site environments.

- In these situations the computer manufacturer will be at a distinct disadvantage in tying the data together through a common data base application facility. This problem is solved in large measure by either of the following:

  - Through the use of SQL as mentioned previously, assuming the functionality is robust enough to support the application. This further assumes active network connectivity through APPC (LU6.2) which seems to have become a psuedo standard.

  - Through the strategic partnering with the major vendors supporting the "other" hardware platforms that complement the hardware vendors. This means the independent DBMS vendors are likely to "win" by embracing a strategy of supporting as many platforms as possible to be in a position to offer the most applications connectivity to its customer base.

5. DBMS HARDWARE VENDORS VITALITY

- Currently, there has been an opportunity for several companies to make a business out of supplying a proprietary hardware approach to solve some of

the major performance requirements of some leading-edge customers. Companies such as Britton-Lee (Los Gatos, CA), Teradata (Los Angeles, CA), and Accel Technology (San Diego, CA) have ventured into this opportunity.

- It is INPUT's belief that these companies served the niche well. However, it is viewed that with the cost/MIP of mini/departmental systems and intelligent workstations coming down the curve these vendors will be hard pressed to market their cost/performance capabilities against off-the-shelf platforms that can support distributed/relational DBMS capability. The bottom line is the general user community will be able to achieve similar performance characteristics with better cost benefits without being encumbered by different hardware, support, and service needs.

6. DISTRIBUTED/ON-LINE APPLICATIONS

- The basis for INPUT's market sizing is its belief that the growth of DBMS use will be fueled by the ability to easily tie data that is currently available and distributed on different physical platforms as well as on different manufacturers' platforms.

- In addition, the performance advantages of hierarchical systems are on the verge of being nullified and serious multi-user on-line transaction-oriented applications are possible with relational systems. Sybase has developed its company based on this premise. Oracle has announced a product, and Relational is right in there as well.

- Finally, the ease of use, development, maintenance, and support for relational DBMS vehicles will fuel growth.

- The issue is whether the potential payoffs and competitive advantages attained by these driving forces is accepted by the data administrator. In other words, the management of the data (and information) needs to be handled

effectively and efficiently. INPUT believes this issue is solvable and likely to be accepted.

B. RECOMMENDATIONS

- INPUT believes there are several ways that companies can participate in the DRDBMS market over the next few years. These companies need to decide in what manner they will participate irrespective of how they may have participated in the past.

- The participation modes are:

  - To market and sell in the corporate market and compete in large measure with IBM. This necessitates data base engine/server efforts in the micro/mini/mainframe platforms.

  - To market and sell tools and complementary products to enhance the users' productivity or ease of use.

  - To market and sell into application niches those end-user applications that satisfy new emerging needs. An example is the use of textual data bases to perform document control and management or image data bases to handle the complex bit map (raster) image data that users are storing on-line for complex documents.

- It is apparent that some companies need to consider where their strengths are and make the appropriate strategic decisions to embark on the participation mode selected.

1. CORPORATE STRATEGY

- To participate in the corporate strategy it will take considerable financial resources as well as a competitive technical advantage. The corporate strategy suggests going "toe-to-toe" with either IBM and/or DEC. Some companies that have been successful in the past may not be so fortunate in the future.

  - This is especially true if they had been slow in entering the relational market or had a large installed base which needed protection from dramatic changes in the user interface.

  - Likewise, some companies expanded into the applications niche arena and found themselves too diluted to pursue that strategy as well as the pure DRDBMS srategy.

  - Furthermore, it is viewed that an essential part of participating in the "corporate" niche is the ability to provide the customer with an easy out to migrate to IBM in the event the user perceives it to be an absolute requirement in the future.

2. TOOLS AND COMPLEMENTARY PRODUCTS

- IBM historically has not fared well in providing user friendly tools and data base development aids.

- A number of companies have excelled in selling 4GL tools and productivity aids in the DBMS environment. Information Builders' Focus and D&B Computing's NOMAD2 have done well in interfacing to quite a number of DBMS and offering the ability to easily develop applications for many users.

- Since this activity is complementary, it does not require the same sort of financial resources as performing the underlying R&D for the data base engine

itself. This provides an opportunity to not be directly competitive with the major DBMS players yet participate in the exciting growth of the market.

- INPUT recommends that those vendors that would like an opportunity to participate in the DBMS market should acknowledge that there will be a DB2 market opportunity. DB2 add-ons, SQL optimizers, DB2 performance monitoring, screen editors, and tablemakers are all areas that are fertile.

3. APPLICATIONS NICHE

- This is the area of the DBMS market that takes the general DBMS capability and packages it to provide an application that provides significant benefit to the users.

  - Taking the new DRDBMS capability and adding applications support in several leading edge areas keeps the vendor yet again one step ahead of the followers. The emerging corporate electronics publishing market is providing impetus for complex documents with portions scanned in to provide the user with complex line art, halftones, and pictures.

  - Project management software systems, image data bases, and document control and management are examples of new areas that need DBMS support. The recommendation is to provide the full solution from an application thrust instead of the general data base itself which would be capable of solving the application need.

  - Several large, mature DBMS vendors have backed into this strategy (even if on purpose) and may not be in a position to maintain the efforts in selling and marketing applications as well as participating in the corporate strategy.

- Wang has announced the Wang Imaging System which will capitalize on the complex and compound document markets. An underlying feature will be the DBMS support for managing the documents. INPUT believes there is a large potential for similar functionality on IBM, DEC, and other platforms.

- Some vendors will see an opportunity to offer applications as a way to offer a total systems approach to certain customers. Selling the application which sits on top of the DBMS pulls through the DBMS for future growth at the customer. This also suggests an opportunity in providing professional services to perform the consulting, design, and implementation in those instances where the customer does not have sufficient resources to develop the desired application.

C. CONCLUSIONS

- The DBMS market is growing overall at an almost 22% rate over the 1987-1992 period. The majority of the growth is occurring in the micro/mini platform. This is due to the new hardware capacity and performance available making the dollar/MIP much less than a mainframe approach.

- Vendors will need to supply their functionality across several platforms to provide viable solutions in the distributed DBMS market. This will be an important factor in distribution of the data.

- Vendors will need to have strong financial resolve and make a commitment to pursue certain segments of the market. Even IBM will have to pick a strategy to execute and/or strategic partners to complement its strategy (note the recent Lotus/IBM announcement).

- IBM will continue its recent success with DB2 and dominate the IBM mainframe market for DBMS.

- The distributed DBMS market will grow primarily in the micro/mini arena tying the disparate corporate data together. The corporate data administrator will buy into the distributed/relational DBMS capability because the data will be protected, controllable, and more useable. Early acceptance of these concepts will provide a competitive advantage.

- There will be a market for DBMS products in the micro arena that will be more a commodity product based primarily on price. These users will be in small self-contained environments and will not need the functionality of the corporate-oriented DBMS. Some existing large companies may suffer significant setbacks unless they redirect their resources to meet the needs of the market.

- There is virtually no limit to the potential of distributed, relational, on-line transaction-oriented DBMS applications over the next five years. The capabilities are in place to allow maximum functionality, connectivity, and price/performance to drive growth in every facet of the information services business sector. The data/information/knowledge realm is about to grow dramatically.

APPENDIX A: QUESTIONNAIRE

QUESTIONNAIRE:

Company Name:_____

Contact: _____ **Date:** _____

GENERAL INFORMATION:
Product: What are the names of your products and when released?

DBMS _____ Original Release Date _____ Current Version _____

Release Date _____

Next Version: QTR, YR? _____

4GL _____ Original Release Date _____ Current Version _____

Release Date _____

Next: QTR, YR?_____

Data Dictionary ____ Original Release Date _____ Current Version _____

Release Date _____

Next: QTR, YR?_____

Other DBMS support packages _____ _____ _____

Are your products designed originally from a relational DBMS perspective? _____Y/N

REVENUE: Fiscal Year Ends _____(Month) Public?_____ (Y/N)

Total Revenue _____FY Most Recent Qtr. _____Current Fiscal Year Est. _____

% Domestic _____ Mix in Next Year _____ _____ % OEM _____

% International _____ _____

2nd Year _____ _____% OEM_____

% OEM _____

% Profit Est. _____

		Previous FY	Current FY	Next FY
What % of Revenue	VAX/VMS	_____	_____	_____
	UNIX	_____	_____	_____
MINI:	IBM PC	_____	_____	_____
MAIN:	CMS	_____	_____	_____
	MVS	_____	_____	_____

Major OEMS: _____, _____,_____, _____, _____

What is your sales channel? _____

FEATURES:

Will you be supporting the following features as part of your DBMS/4GL feature strategy?

		Time Frame	Warrant Price Change or Additional Price	With Whom?
Distributed Data Bases		_____	_____	
Interconnected Data Bases		_____	_____	_____,_____
Other DBMS gateways		_____	_____	_____, _____
Data Dictionary	Distributed	_____	_____	
	Central	_____	_____	
	Global	_____	_____	
SQL		_____	_____	
Text Data (type)		_____	_____	
Image Data (type)		_____	_____	
Artificial Intelligence hooks?		_____	_____	_____,_____
Spreadsheet hooks?		_____	_____	_____,_____
SNA Support		_____	_____	
	Bisynch	_____	_____	
	3270	_____	_____	
	LU 6.2	_____	_____	
Optical Disk Support		_____	_____	_____,_____

Do you support 4GL capabilities? _____

What is your view on 5GL? _____

_____

_____

What is your view on performing benchmarks? Essential to the sales process? Automatic compression algorithms? _____

_____

What is your view on DBMS standardization? (Please speak to your evaluation of the three-schema proposal? also DIF?) _____

_____

_____

How do you provide data base security? _____

_____

_____

How do you provide data validity, protection from loss? _____

_____

Do you provide concurrent operation for read ? _____ and write? _____

How does it protect/ensure data accuracy? _____)

What and when is your strategy to embrace additional hosts/platforms? _____

_____

If many industry players build PC DBMS compatible to their mini/mainframe versions, what is your opinion on the continued success of Ashton-Tate? _____

_____

What is your competitive advantage, i.e., your basis for business success? _____

_____

_____

Who is your most common competitor? _____

Who gives you the most difficulty (by host if possible)? (Please see next page) _____

_____

Host:	IBM PC	Competitor _____
Host:	VAXEN/VMS	Competitor _____
Host:	UNIX	Competitor _____
Host :	IBM Mainframe	Competitor _____

What are the five largest business arrangements/partnerships/deals you have entered into in the past year? _____

_____

What other information do you believe should be covered that has not already been mentioned? _____

_____

_____

THANK YOU FOR YOUR CANDID REMARKS!