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Abstract

According to the companies surveyed, a key factor in migrating to C/S systems is compatibility with the existing computer environment. This report forecasts growth in the number of servers, number of clients and ratio of clients to servers in a C/S system. It shows preferences for operating systems, computing platforms, databases and networks. Future directions and reasons for platform selection are given. Key issues for buyers are ranked.

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The Client/Server Explosion–How Users Choose Platforms

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A

Introduction

As the movement to client/server (C/S) computing accelerates, the variety of platforms (network, operating system and hardware) deemed suitable as integrated C/S platforms seems limitless. The decline of mainframe computing and resulting erosion of IBM standards, that dominated corporate computing architecture for the past 20 years, has created both confusion and new opportunities for equipment, software and services vendors.

Purchasers confronted with selecting an architecture for migrating to C/S have some difficult decisions to make. Gaining an understanding of how they make these decisions today and what they anticipate as future requirements is critical to vendors in the information services market.

This study focuses on:

- Current platform directions
- How and why these platforms are selected
- How C/S platforms are likely to change in the future

A Objectives

The study provides insight into computer equipment, software and network platforms that dominate the migration to C/S. It addresses questions such as:

- Are there clear leaders emerging in terms of platform type or vendor, in equipment, software and network management components of C/S platforms? Are there combinations that dominate?
- What are the reasons a user will pick one platform over another? Are reasons predominantly technology or business-driven?
- Who decides on the architectural direction and who makes the buying decision?
- What future changes in platform choices are likely, and why?
- Do prior relationships affect the choice of vendors and platforms, and how important are they?
- Are there current limitations users see as barriers to the continued migration of applications to C/S platforms?

B
Scope

The study's scope includes identifying equipment, operating systems and database management software associated with both clients and servers. Network management systems and applications development tools are also identified. Information regarding selection reasons, selection process and future plans are analyzed on a component basis.

Study survey data is from firms representing a broad base of industry sectors within the United States.

C
Methodology/Demographics

1. Methodology

- INPUT conducted 124 in-depth telephone surveys with information systems (IS) or user operating management to obtain the data for this analysis. Appendix B contains the questionnaire.

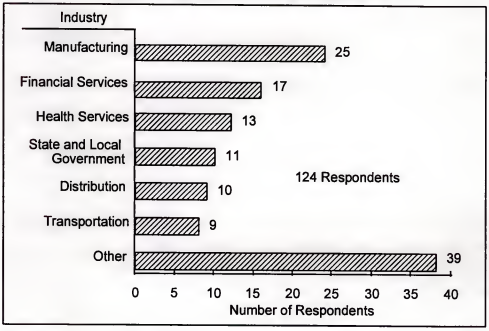
- Most interviewees (80%) were culled from INPUT's database identifying planned development for more than 2,200 applications for the 1993 to 1995 time frame. The remainder were respondents to other surveys supporting C/S research during the latter half of 1993.
- All survey respondents were implementing or had specific plans to implement C/S technology in 1994.
- The data was coded and tabulated for analysis. This analysis, along with secondary research and data from other INPUT research on C/S computing, was used prepare this report.

2. Demographics

In general, the data represents a significant cross-section of industry groupings, as shown in Exhibit I-1.

Exhibit I-1

Number of Respondents by Industry



The other category contains representative companies from utilities, telecommunications and business services. The federal government sector was not surveyed.

Exhibit I-2 and I-3 shows distribution of sales volumes and the number of employees for companies participating in the survey.

Exhibit I-2

Distribution of Respondents by Sales Volume

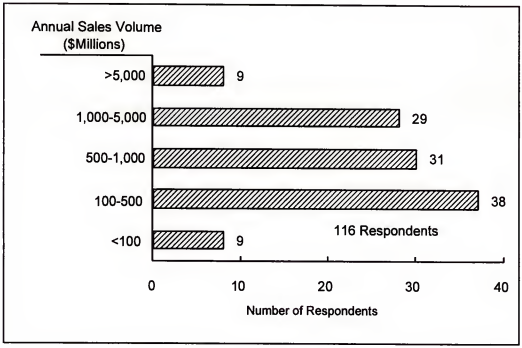
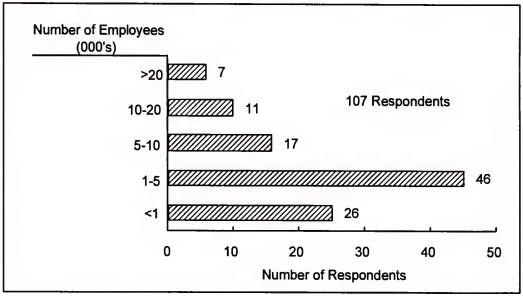


Exhibit I-3

Distribution of Respondents by Number of Employees



D
Platform Definitions

At best, the term "platform" is ambiguous. It ranges from a reference to a standalone equipment configuration to integrated assemblage of equipment and software components (operating system, database and network management) that create the environment in which applications are developed and operate.

Throughout this report, the term "platform" will be used in a variety of contexts. To provide consistent context, the following definitions apply:

- **C/S Platform**—Integrated set of equipment, operating system, database management and network management software encompassing both client and server equipment components to support the development and operation of C/S computing applications
- **Server Platform**—Integrated set of equipment, operating system, database management and network management software operating on the server component of the C/S platform
- **Client Platform**—Integrated set of equipment, operating system, database management and network management software operating on the client component of the C/S platform

In addition, the term "platform" may be used in direct reference to either client or server equipment. These references are intended to refer only to the equipment component.

Other INPUT definitions of industry-specific terms used throughout the report are contained in Appendix A, Definitions.

E
Organization

The remainder of this report is organized into four chapters:

- Chapter II, *Executive Overview*, provides a summary of the findings of this study.

- Chapter III, *Client/Server Platform Preferences and Directions*, presents INPUT's analysis of leading C/S platform architectures, dominant configurations and general buyer selection criteria. The chapter also discusses the platform selection process as well as future directions in equipment and software.
- Chapter IV, *Analysis of C/S Platform Components*, discusses each major platform component in detail, including:
  - Equipment
  - Operating systems software
  - Network operating systems
  - Database management systems
  - Application development technology
- Chapter V, *Buyer Issues*, analyzes the impact of business and technology issues influencing C/S platform trends, as well as the impact of legacy environments.

F
Related Reports

INPUT has published the following related reports in the Client/Server Applications and Markets program:

- *Client/Server Applications Trends–Banking and Finance*
- *Client/Server Applications Trends–Insurance*
- *Client/Server Applications Trends–Discrete Manufacturing*
- *Client/Server Applications Trends–Process Manufacturing*
- *Client/Server Applications Trends–Health Services*
- *Client/Server Applications Trends–Telecommunications*
- *Client/Server Applications Trends–State and Local Government*
- *Client/Server Applications Trends–Retail Trade*

- *Client/Server Applications Trends–Utilities*
- *U.S. Client/Server Market Analysis, 1993-1998*
- *Client/Server Service Opportunities–Europe, 1993-1998*
- *Client/Server Impact On Major Project Contracting–Europe, 1993-1998*
- *Client/Server Trends In The Federal IT Market: 1994*

In addition, INPUT reviews vendor strategies in its Client/Server Profiles.

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Executive Overview

Three forces primarily drive client/server (C/S) computing as a systems strategy for a growing number of companies:

- Corporate computing reshaping—to better meet the needs of downsized and networked organizational structures
- Faster response time—for both transaction processing and inquiry-based business systems to keep up with the pace of business
- Cost reduction—by leveraging the price performance advantages of desktop processing power

Just as centralized hierarchical computing fits organizational requirements of the 1960s and 1970s, the C/S model is a logical approach for the distributed company of the 1990s.

The environment companies select for their C/S technology platforms is considerably different from the 1970s:

- In the 1970s, architectural choices were greatly limited.
- Alternatives were controlled by a handful of vendors.
- Applications software was typically written for a single proprietary architecture.
- Computing power is now affordable on every desktop.
- As network protocols matured, connectivity, that was customized in the 1970s, became standardized.

This study focuses on how companies make C/S platform selections from the myriad of potential alternatives. Based on data gathered from 124 companies from various industries, the study identifies:

- C/S platforms
- Selection criteria
- Those involved in the selection process

Potential changes in C/S platform architecture are also analyzed.

This chapter summarizes the key findings and presents INPUT's conclusions and recommendations.

A
Preferences and Trends

1. C/S Platform Preferences

a. Typical Platform Configurations

More than 90% of respondents plan to use Intel-based PCs as their client platforms. Of these, 90% will run DOS/Windows operating software. Most companies believe capabilities of available or announced Intel-based systems will adequately support client processing. Traditional workstations will be used as client equipment platforms where high compute capacity is required.

In at least 75% of the cases, Intel-based PCs and workstations are the targeted server equipment platforms, with DOS the dominant operating system for PCs and UNIX for workstation-based systems. Whether workstation or PC-based, most companies (80%) plan to use relational or distributed relational database technology as the primary platform for C/S computing applications.

For client and server platforms, relational and distributed relational database software will provide the platform for applications. Relational databases are defined for the purpose of this report as databases that follow the relational model and process transactions on a single processor. Distributed relational databases can process transactions across multiple processors. Examples of relational databases are FoxPro and Paradox. Oracle and Sybase support distributed relational processing. INPUT

asked users to identify whether their database was relational or distributed relational.

NetWare comprises 70% of the network communications software.

Exhibit II-1 compares typical client and server platforms and estimates the probability of major architectural components based on survey data analysis.

Exhibit II-1

Typical Configurations for Clients and Servers

Component	Architecture	Probability (%)	
		Client	Server
Equipment Intel-based PC	Workstation	.08 .90	.35 .40
Operating System UNIX	DOS	.80 .10	.60 .40
DBMS Dist. Relational	Relational	.40 .20	.25 .45
Network OS	NetWare	.70	.70

Buyers reported that:

- They are generally comfortable with C/S systems.
- Their platform selections meet immediate requirements.
- They are frustrated that no off-the-shelf solutions provide seamless integration of the major C/S platform components.
- They frequently pick each component independently and accomplish integration on their own.

Business and environmental factors encourage a cautious approach to C/S systems development. Companies are surprisingly conservative in their approach to building integrated C/S platforms, relying on proven solutions, as shown by the following:

- Most companies take a step-by-step migration approach to C/S systems, implementing one application suite at a time.

- To ensure new or re-engineered C/S applications can be integrated with legacy systems, compatible architectures are needed. Respondents rated "compatibility with existing environments" as an influencing factor on overall platform selection an average of 4.2 on a scale of 1 to 5 (5 high).

- Existing investments in Intel-based PC equipment and local-area networks (LANs) are already extensive. Respondents feel there are no alternatives with benefits significant enough to cause most companies to abandon that investment.

- Windows has rapidly become the *de facto* user interface standard. Companies invest considerable energy in user training and enjoy access to the rich set of applications and applications enabling software available through Windows. They see no need to switch.

The most important factor influencing companies currently using Intel-based PCs to evolve these platforms into full-fledged C/S environments, rather than take a more aggressive path, is that there are no clear-cut alternatives.

- Windows NT, the logical growth step for Intel-based servers, is perceived by many buyers as unproven.

- A standard for UNIX is elusive. Off-the-shelf UNIX-based office applications are not as widely distributed as corresponding DOS or Macintosh applications. To date, the market share of UNIX operating systems on Intel architecture is not as high as on RISC-based processors.

The one area where companies are aggressive about investing in newer technology is database management software. Migration to C/S accelerates the trend to distributed relational database management systems. There are two motivating factors:

- The underlying premise of C/S computing is that the application's data and processing elements will be distributed over multiple platforms, optimizing the applications functionality. Traditional single-platform hierarchical data management systems cannot support this requirement.

- Distributed database management systems also provide:
  - Applications development tools or applications templates to facilitate application re-engineering and development
  - Heterogeneous platform support, insulating the application investment, somewhat, from changes in equipment and operating systems platforms

In summary, most companies take an evolutionary approach to C/S platform architecture, using what they have in place wherever possible. This is particularly true in the case of server platforms, where the NT versus UNIX issue complicates the selection process. In the meantime, companies are focusing on data management and applications.

b. The Evaluation and Selection Process

Despite heavy user involvement in applications design and development, the information systems (IS) organization dominates the C/S platform design and its component selection.

- Respondents rated the importance of central IS in the selection process, on average, 4.1, on a scale of 1-5 (5 high).
- In 95% of the sample cases, central IS actually made the decision.

However, compared to technology evaluation and selection processes of a few years ago, users today are extensively involved in the C/S platform selection. For example:

- Approximately 40% of respondents actually specified applications requirements prior to technology selection. This is a direct reversal of many processes used in the 1970s and 1980s where IS selected technology based on overall assessment of corporate needs. Users' specific applications requirements were frequently molded to fit the selected platform's capabilities.

- Although corporate IS is the final authority most of the time, it is a team approach with heavy user involvement. In situations where divisional IS staffs exist, they frequently represent user management on formal project teams by:
  - Translating user management's business applications requirements to functional technical requirements for the C/S platform
  - Conducting pilot tests and product evaluations as part of the overall platform selection process
- In many instances, users reserve a "veto" power over the final selection, particularly on those platform components providing direct interfaces to their applications such as graphical user interfaces and database management software.

Outside and vendor consultants have a surprisingly low impact on C/S platform selection. The average ratings for influence on the selection process was 2.4 for general consultants and 2.1 for vendors. This is a dramatic change from the days when the major hardware vendors virtually controlled the overall platform strategy. Undoubtedly, this general disregard for consultants is because no single hardware or software company dominates more than one or two platform components. Two situations where companies rely heavily on outside services are:

- To obtain technical expertise on a specific platform component, such as operating system or database management software elements
- To provide and/or manage an overall process for re-engineering major applications suites

Many systems integrators, including EDS and Andersen Consulting, have developed methodologies for C/S re-engineering, resulting in rapidly growing business opportunities. Certain hardware vendors, such as Digital Equipment, Hewlett-Packard, Unisys and NCR are gaining ground in developing and managing C/S migration in specific industries.

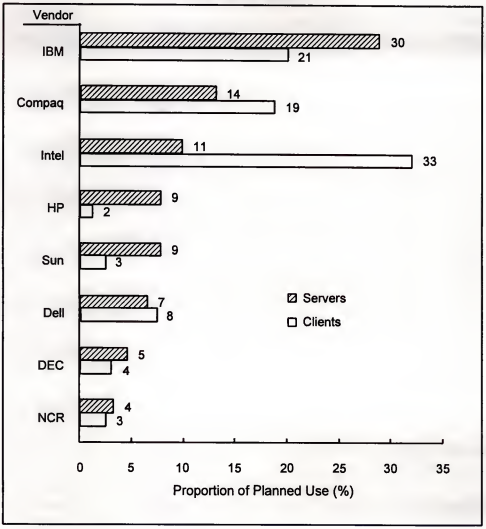
Today, most companies select their platform components with very little outside assistance.

2. Vendor Preferences

There were few surprises in the survey findings regarding preferred hardware vendors. Exhibit II-2 shows leading vendor penetration for client and server equipment.

Exhibit II-2

Planned Penetration Rates for Vendors Servers and Clients



- IBM is represented in all categories of servers, including mainframes, minicomputers, workstations and PCs, as well as AS/400 and RS/6000 midrange platforms.
- Sun Microsystems, Hewlett-Packard and IBM RS6000 computers will make up 83% of the total server workstation population.

- Intel-compatible (including Intel) processors and PCs from IBM, Compaq and Dell collectivel, will account for 80% of client equipment.

Two additional points worth noting regarding client and server equipment are:

- PC users are willing to pay for reliability or support services from quality manufacturers, providing the fee is small.

- IBM will continue to be a significant hardware vendor, despite aging equipment and costly sales support, because of its large installed base and extensive customer knowledge.

Microsoft dominates operating systems software largely because of the heavy commitment, at least for the moment, to DOS on servers and DOS/Windows on clients.

In analyzing the less than 10% of users who were not using DOS/Windows clients, it was observed that:

- Those planning to use UNIX on an Intel platform prefer the Santa Cruz Operation (SCO) system to competing systems, such as Solaris from SunSoft.

- Those using UNIX on workstations, such as Sun or HP, will remain with those vendors' proprietary versions of UNIX.

Novell, clearly, leads in network operating systems. More than 70% of the sample indicated they would use NetWare because of its flexibility and openness.

Oracle and Sybase emerge as preferred vendors for distributed database management software. Survey results show Oracle has a 22% penetration rate for servers, while Sybase has a 15% rate. Oracle also has the highest client penetration rate. However, many other vendor products have heavy client penetration from legacy work group and personal computing applications.

3. Future Trends and Requirements

a. Future Trends

Survey results indicate significant growth in C/S platforms over the next several years. Exhibits II-3 and II-4 show the largest growth rates for clients and servers are likely to occur early in the next five-year period.

Exhibit II-3

Forecasted Growth in Average Number of Clients 1993-1997

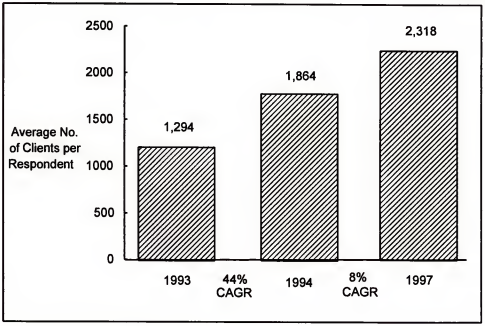
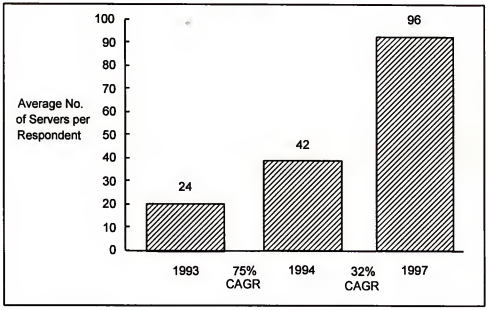


Exhibit II-4

Forecasted Growth in Average Number of Servers 1993-1997



- Significant compound annual growth rates (CAGRs) will continue throughout the period, although the client rate will decline as the ratio of client platforms per employee approaches one-to-one.

- The ratio of clients to servers will decline as more application suites migrate to servers, creating additional capacity demands.

For most companies, a radical deviation from its current platform selections is not likely in the near term. Nevertheless, almost all companies surveyed will continue to monitor key developments, particularly operating systems and applications development tools.

- Most companies with large mainframe environments will migrate as many applications as possible to smaller C/S platforms. Those with significant on-line transaction processing (OLTP) requirements will process most of these applications on mainframes until alternate technologies are proven.

- The migration to distributed relational databases will accelerate. These systems offer the best alternative platform for applications development and re-engineering within the C/S computing framework, promising some level of portability across heterogeneous operating system and hardware platforms.

  As this migration occurs, applications development tools specifically designed for systems such as Oracle and Sybase will significantly grow .

- Companies will monitor developments in operating systems and network management. Assuming NT meets expectations, it will replace DOS-based servers and slow down or reverse the ongoing erosion of server platforms to UNIX.

- Current plans call for 80% of the servers to host multiple applications suites as well as provide utility support for printing and local work group computing. In the future, many companies will add specialized servers to the network to handle functions such as image management, on-line transaction processing and messaging.

b. Future Requirements

Even though current technologies adequately meet most C/S platform requirements, the study identified four major areas for improvement:

- *Application Program Interfaces (APIs)*—Over the long term, the most significant investment companies will make as they migrate to C/S computing will be in applications. Consequently, they want standard interfaces between C/S platform components that allow applications portability across heterogeneous hardware and operating systems environments. Industry standard APIs go a long way toward meeting this requirement.

- *On-line Transaction Processing (OLTP) Capabilities*—While recent developments in distributed relational database software have significantly enhanced this technology's attractiveness for high-volume OLTP applications, there are still limitations. Higher integrity on transaction "commits" and more efficient processing algorithms will be required to meet many companies' future needs.

- *Systems Management Capabilities*—In general, hardware and software platforms that companies install for C/S computing are woefully lacking in systems management and control capabilities. Backup and recovery, resource optimization and capacity planning and management are critical to the successful management of C/S networks as they expand from departmental systems to enterprise-wide platforms.

- *Applications Software*—The lack of *de facto* C/S platform standards has left many applications software products developers in a dilemma. If they pick the wrong platform for implementing C/S versions of their offerings, they run significant financial risks. As a result, very few applications software products designed for C/S computing are available. Yet, current demand is high and will continue to grow.

B
Analysis

This report only interviewed a relatively small sample. However there are some concerns that users are not selecting the most cost-effective solutions. For example:

- Emerging vendors like Trinzic and NetFrame, who provide affordable Intel-based servers, were not mentioned.

- Apple was barely mentioned despite having a robust client networking solution.

- Novell was highly regarded by users, despite its lack of clear vision for the future. For many networks, a simpler solution like Windows for Workgroups could be more cost-effective.

The user concern for supporting the installed base may mean the infrastructure (networks, clients and servers) will not be upgraded fast enough to support emerging technologies such as:

- Desktop video conferencing
- Object-oriented operating systems (from NeXT and Taligent)
- Multimedia

The above technologies may be slower to "take off" in mass market platforms than anticipated. Companies need to budget for workstation class machines (either Pentium or traditional RISC processor-based) with multitasking operating systems (such as Chicago) and at least 16MB of memory now if users are to benefit from technology advances in 1995.

C
Conclusions and Recommendations

Findings presented earlier lead to a number of general conclusions on how the C/S platform environment will evolve over the next several years:

- **Most companies will go with installed technology**, providing their own platform integration, as required, because of uncertainty regarding operating system standards.
- Information services vendors must deal with **heterogeneous C/S platforms**, given the high growth rate expected in both client and server environments over the next two to three years.
- **Buyers focus on the database layer and user interfaces.** Databases interface between applications and the rest of the infrastructure. Therefore, buyers perceive the selection of operating systems as less critical and treat the hardware component as a commodity.

- **The final decision on C/S platform architecture is likely to be in the hands of IS,** although the decision making process is much more heavily influenced by users application requirements and their direct participation in platform selection projects.

- **Vendors and consultants have had little impact on C/S platform selection.** The installed base typically determines what platform is selected.

These overall conclusions lead to INPUT's recommendations.

- **Professional services companies and systems integrators** need to invest heavily in training, both for UNIX and Microsoft operating environments, as well as build or revise their existing methodologies to deal with C/S application implementation. With these capabilities in place, there will be a wealth of opportunities for re-engineering existing applications or building new custom applications suites.

- **Distributed relational database software companies** should invest (or continue to invest) in applications and development tools to be used in conjunction with their products. Developing professional services offerings as an additional line of business will also permit them to capitalize on growing user demand. CASE software companies have a similar opportunity.

- **Applications software products firms** should direct their efforts toward building applications that rely on leading relational database products as host platforms.

- **Systems software companies** should focus on developing products that seamlessly integrate leading client, server and network operating systems by improving connectivity and standard applications programming interfaces. "Middleware", that addresses connectivity and data exchange issues in today's heterogeneous C/S environments, will be in high demand.

- **Systems software firms** should also fill the gap in systems control by offering software design to support C/S infrastructure.

- **Hardware vendors**, particularly those of Intel-based platforms, need to establish a brand image with the user by supporting value-added services.

- As C/S networks grow to an enterprise-wide scale, many firms will outsource some management of their C/S infrastructure to third parties. **Outsourcing firms** that develop technologies and methodologies to address C/S needs will see increased opportunities to offset the decrease in traditional mainframe outsourcing.

Traditional hardware companies that do not participate in the software and services portion of the market face grim prospects. Margins on C/S platform equipment components will continue to drop, reflecting heavy competition and the buyer's view that hardware is a commodity. Markets for specialized servers such as massively parallel (MPP) and symmetric parallel processing (SMP) systems, will offer windows of opportunity, as will multimedia. The C/S revolution will be driven primarily by software and professional services firms with whom any successful hardware manufacturer must partner.

Client/Server Platform Preferences and Directions

This chapter examines current C/S platform selections and future directions. It addresses questions such as:

- What are the primary driving forces that lead to selecting an integrated C/S environment?
- What combinations of hardware, operating systems software, database management and network management systems will be used?
- What, if any, changes do companies plan for platforms in the near term?
- What roles do various internal and external organizations play in the selection process, and to what degree?
- Which components of currently selected platforms are likely to change over time, and why?
- What do companies forecast for C/S platform growth over time? Will the mix of clients and servers change, and why?

Part of the analysis focuses on the integrated platform. Chapter IV presents a more detailed discussion of each platform component, selection criteria and vendor preferences.

A
Leading C/S Platform Architectures

The huge variety of combinations of client and server hardware, operating systems, database management systems and network operating systems identified in the survey argues that almost any combination of components can, and likely will, be used by some organization as a C/S platform. However, survey results indicate that some leading combinations have already emerged.

1. Dominant Platform Configurations—Servers

Exhibit III-1 shows which combinations of components are likely for each class of server platform. The probability (PR) representing the likelihood of the occurrence of a component type are estimates, based on data from the survey sample.

Exhibit III-1

Typical Server Platform Configurations

Hardware		Operating System		DBMS		Network OS	
Class	PR	Type	PR	Type	PR	Type	PR
PC	0.40	DOS	0.60	Relational	0.40	NetWare	0.70
		UNIX	0.25	Dist. Rel.	0.20	Other	0.30
		Other	0.15	Other	0.40		
Workstation	0.35	DOS	0.25	Relational	0.70	NetWare	0.65
		UNIX	0.65	Dist. Rel.	0.20	Other	0.35
		Other	0.15	Other	0.10		
Mainframe	0.15	DOS	0.20	Relational	0.50	NetWare	0.85
		UNIX	0.15	Dist. Rel.	0.40	Other	0.15
		Other	0.65	Other	0.10		
Minicomputer	0.10	DOS	0.20	Relational	0.10	NetWare	0.55
		UNIX	0.20	Dist. Rel.	0.15	Other	0.45
		Other	0.65	Other	0.75		

Together, PC and workstation-based servers represent about three-quarters of the target server platform environments, with DOS dominating the operating systems environment for PC-based servers and UNIX for workstation-based systems. Whether workstation or PC, both server platforms will heavily use relational or distributed relational database systems; seven out of ten times, NetWare will be the prevailing network operating system. Exhibit III-2 shows the typical server components for combined classes of workstations and PCs.

Exhibit III-2

Typical Server Configuration

Workstation or Intel-Based PC

Component	Probability
Operating Systems	
UNIX	.40
DOS	.60
Database Management Systems	
Relational	.25
Distributed Relational	.45
Network Operating System	
NetWare	.70

a. Mainframes

Mainframes are probably under-represented in the sample. At least eight respondents who did not include mainframes in the server category, indicated they would, to some degree, support C/S

computing. However, in these cases respondents didn't consider the mainframe the primary server. This suggests one of the following:

- As long as a significant proportion of enterprise-wide applications remain on mainframe environments within a corporation, they will be used in a three-tiered architecture as data servers or even clients, for applications whose primary processing has already been downsized to a C/S platform.
- Mainframes and their legacy network environments, at least for the interim, will play a role in interconnecting various C/S applications.

b. Minicomputers

The sample data shows minicomputers play a minor role in the future of C/S computing. The IBM AS/400 and DEC VAX equipment appear to lead. At least five respondents said minicomputers would be used for some specialized server function. The sample was biased toward business applications, as opposed to engineering and scientific environments where minicomputers are more likely to be part of the C/S configuration.

c. Server Specialization

While specialized servers play a role in the future of C/S computing, the general trend is toward multifunctional servers. The survey data indicates that just less than 30% of planned servers will be specialized or dedicated. Of these, more than one-half were dedicated to specific functions such as:

- Engineering graphics
- Imaging
- Communications

Most of the remainder of the specialized servers will be dedicated to a single departmental business application. However, even these will be used to support integrated office functions.

While most companies move to C/S computing one application at a time, they are planning for an environment that will support multiple applications as well as utility functions, such as printing, through a single server platform.

2. Dominant Platform Combinations—Client

Even though a variety of platforms are selected on the server side, the client side is clearly dominated by the Intel-based PC running DOS/Windows. Traditional workstations continue to have their niche where high compute capacity is required, but few companies believe that capabilities beyond those of currently available and/or announced PCs will be required in the client environment. In fact, 90% of the survey respondents target Intel-based PCs as the client platform.

As shown in Exhibit III-3, DOS running under Windows will be the operating system of choice.

As with servers, client platforms will rely heavily on relational database technology as the primary application platform. This is consistent with the general trend, but in the case of C/S platforms, the commitment to relational (70% for servers and 60% for clients) exceeds INPUT's estimates for the use of relational on traditional mainframe platforms by 15% to 20%, reflecting:

- The functional capabilities of relational systems to facilitate rapid and less expensive application development, maintenance and modification
- The unique characteristics of distributed relational systems to manage data distribution and transaction concurrency across multiple heterogeneous platforms

Exhibit III-3

Typical Client Configuration

Intel-Based PC

Component	Probability
Operating Systems	
UNIX	.10
DOS/Windows	.80
Database Management Systems	
Relational	.40
Distributed Relational	.20
Network Operating System	
NetWare	.70

Based on respondents' future plans (Section C) , growth in relational technology will accelerate as legacy systems are re-engineered for C/S platforms.

3. Summary—Leading C/S Platform Architectures

Overall, the survey data leads to these conclusions:

- Workstations or PCs running existing operating systems will dominate server platform selections in the immediate future, with Novell's NetWare providing the connectivity between servers and clients in most cases.
- Relational and distributed database systems will provide the application platform for servers and clients. DOS/Windows will provide the key user interface for client workstations.

The survey data supports these statements regardless of company size or industry. Cross-tabulations based on these two respondent characteristics failed to yield any significant variation in overall platform or platform component selection. The one exception is that the largest firms will use mainframes as servers more frequently than smaller companies. The obvious reason is that these firms are more likely to have heavy investments in mainframe hardware and applications. Not a single respondent suggested buying a conventional mainframe, now or in the future, for specific use as a server.

Finally, notable by its absence, is any mention of Apple's desktop systems as primary targets for either the server or client platform. This is because Apple systems are typically used in specialized departments, such as publishing and marketing, areas not focused on in the survey.

4. Overall Buyer Selection Criteria

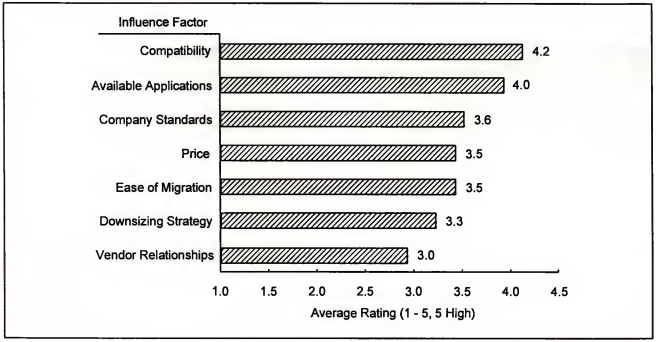
Respondents rated the importance of a number of factors regarding their overall C/S platform selection. They ranked each of the following on a scale of 1 to 5:

- Compatibility with current operating/network environments
- Availability of applications software
- Corporate or divisional technology standards
- Price
- Ease of migration of existing applications
- Corporate strategies with regard to downsizing
- Strength of vendor relationships

As shown in Exhibit III-4, compatibility with existing environments has the most significant impact on platform selection.

Exhibit III-4

Rating of Factors Influencing Platform Selection



a. Compatibility

Compatibility ranking is consistent with other data gathered in the survey on why individual platform components were selected. On average, 25% selected a particular technology primarily because it was already in place. While there are variations in this tendency to go with what is in place depending on the platform component, the 25% average gives a strong indication the movement to C/S is proceeding in a relatively conservative way in order to:

- Minimize the risks associated with a radical platform shift that respondents believe is unnecessary to accomplish the transition
- Leverage existing investments in both technology and training
- Permit newly migrated applications suites to "peacefully" coexist with those that have yet to undergo transition or, in fact, never will

b. Availability of Applications

The high ranking of application availability as a selection criterion, reflects the strong desire to use as many off-the-shelf applications as possible. This idea is reinforced by the fact that respondents rated the availability of applications (tied with compatibility) as the most significant factor influencing database selection.

c. Other Factors

- *Company Standards*—Company standards still play a significant role in the overall platform selection process. Typically, corporate standards managed by IS departments restrict the ability of user organizations to select their own equipment.

- *Price*—With an average rating of 3.5, price is a relatively significant consideration, but further examination of the data shows that its importance varies by platform component. Exhibits IV-3 shows that price ranks as the second most critical selection criteria in the case of equipment, where most respondents took a commodity view. Exhibit IV-19 price ranks fourth out of five selection criteria in the case of database software systems, where functionality is the most critical factor.

- *Ease of Migration*—Ease of migration also got an average rating of 3.5. When companies planning to install new systems, as opposed to enhancing existing systems, are eliminated from the sample, ease of migration has an average rating of 4.2 and is the most dominant influencing factor in the selection process.

- *Existing Vendor Relationships*—In general, survey respondents thought existing vendor relationships were the least important factor influencing their selection processes. Even for companies that plan to use installed technology, the average rating on this factor was just 3.1. In part, this ambivalence results from:

  - Today's heterogeneous equipment environments, where the strategies of individual vendors have less impact

- Increased price competition between hardware vendors and leading companies to purchase client PCs from superstores or mail order vendors, such as CompUSA or Dell

Chapter V, Buyer Issues, contains a more detailed discussion of the overall impact of existing vendor relationship on platform selection.

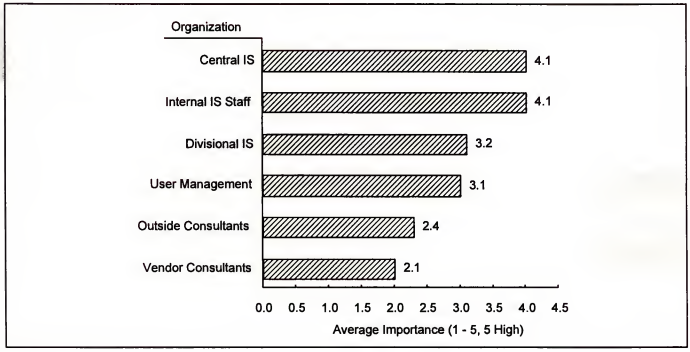
5. The Role of IS, Users and Third Parties in Platform Selection

The general trend toward more direct user involvement will continue. However, IS still clearly leads regarding C/S implementations.

A significant portion of the survey was devoted to identifying the role that various organizations (internal or external) play in the evaluation and selection process. Exhibit III-5 shows the dominant influence of IS on the overall process.

Exhibit III-5

Rating of Factors Influencing Platform Selection



This finding is not surprising. Technology platforms selection has traditionally been one of the primary responsibilities of IS. And, despite the growing involvement of users in applications

development and maintenance, most firms still look to either a corporate or divisional technical organization for support in network and technology integration, where in-depth technical knowledge is a critical factor. In the case of C/S platforms, where multivendor solutions are the norm, a solid technical understanding of exactly how the platform components will work together is an essential ingredient for success.

On the other hand, given the limited experience most firms have with implementing medium- to large-scale C/S systems, it is somewhat surprising that the impact of outside and vendor consultants on the selection process is below 2.5.

a. The Role of Outside and Vendor Consultants

The reasons outside consultants, equipment vendors, software vendors or others are currently less influential than might be expected is probably because:

- Companies seeking unbiased outside support or assistance in the platform selection process are hard-pressed to identify consulting firms with demonstrated performance records.
- Individual equipment or software vendors are perceived as having only partial solutions to the overall platform design requirement and are not necessarily viewed as unbiased.
- As indicated by the survey, most companies will not make a radical departure from their existing hardware and operating systems platforms and believe consulting on, at least, those platform components, is unnecessary.

However, the situations where respondents cited a significant influence of outside and/or vendor consultants on the selection process, provide some insight as to how the role of consultants might develop over time.

- Fifteen respondents indicated they used consultants to gain an in-depth understanding of some aspect of the technology of their targeted platforms where in-house expertise was nonexistent or inadequate. And, without external expertise, the overall selection process would have been slowed down or their confidence in the viability of the final selection would have been low.

- At least six respondents said the selection of some component of the platform architecture was dictated by consultants or vendors with specific applications packages. For example: "If you want this application, it runs on Oracle."

- Four respondents said they use systems integrators and rely on them to select the platform components within reasonable constraints imposed by their installed environment.

Although additional research would be required to document any trends about the future use of consultants in the C/S platform selection process, this survey's findings indicate there is a need for outside consulting services in at least two areas.

- Selection and support on specific technologies within the context of a general platform architecture

- Processes for managing general purpose C/S platform selection that can support a reasonable balance between existing and future applications requirements

Specialized consulting firms that meet the first of these requirements are emerging on a daily basis. The number of firms that offer an approach that links applications planning directly to platform selection is presently limited. Those that do, approach the problem from the viewpoint that C/S technology is a new platform architecture that existing re-engineering, design and development processes must successfully accommodate. For example:

- The EDS RightStep program is a developed process to support customers and prospects in the total migration from goal definition to implementation of C/S downsized environments. Typically, EDS acts as the prime contractor in these efforts, but will form alliance partnerships in individual cases where platform specifications require the assistance of a major hardware vendor.

- Andersen's overall approach to C/S is to integrate the architectural concept into its existing lines of business and product offerings such as FOUNDATION, Andersen's overall development and CASE methodology. Andersen Consulting's client/server migration strategies focus on technology along with personnel and process factors. These factors are brought together in an overall target architecture through a process Andersen calls Selective Engineering.

Both of these approaches start at the highest level of planning and work their way down to the actual platform selection. Other consulting and systems integration firms provide similar structured offerings to deal with C/S platform selection. As buyer recognition of these capabilities increases, so will the influence of consultants and systems integrators in the determination of C/S platform choices. In the meantime, most firms rely primarily on their IS staff to make the selection.

b. The Role of Information Systems (IS)

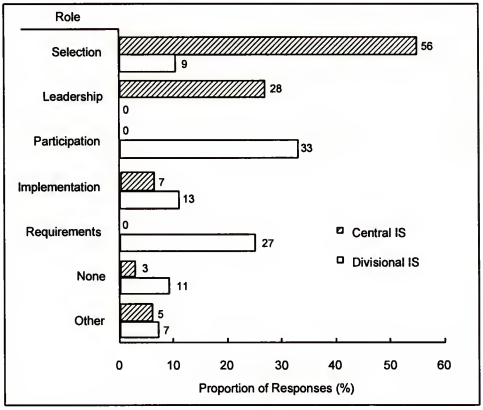
In addition to rating the influence of various organizations on the selection, respondents described what role central IS, divisional IS and users played in the selection process. Exhibit III-6 compares the roles of central and divisional IS.

Following are descriptions of the role categories:

- *Selection*—Evaluation of alternatives and actual selection of the platform's hardware and software components
- *Leadership*—Management of the overall evaluation and selection process; for central IS, this would also include approving C/S platform selections made by multiorganizational project teams or establishing architectural standards within which other organizations may select C/S platforms
- *Participation*—Technical staff provided to multiorganizational C/S selection project teams
- *Implementation*—Carrying out the necessary steps to install the selected platform components

Exhibit III-6

Comparison of Central and Divisional IS Roles in C/S Platform Selection



- *Requirements*—Developing application requirements and/or technical specifications. These are used to specify the system architecture, features and components for programmers

- *None*—No involvement in the selection process

- *Other*—Includes responses not readily placed in other categories. Typical responses in this category include selection of an outside consulting firm, analysis of existing installed base, etc.

It should be emphasized that respondents were asked to describe the *primary* role played by the organization. This explains what appears to be some anomalies in the exhibit. Obviously, where central IS was dominant in selection, it also participated in the process. But the exhibit shows zero percentage for "participation" by central IS. The same logic applies to the "requirements" category.

Regardless, a relatively clear picture of the roles played by central and divisional IS in the selection process emerges:

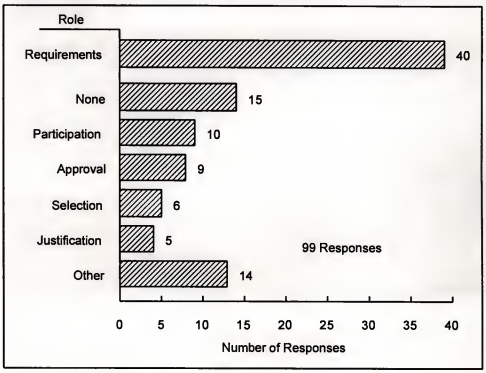
- Central IS evaluates, manages the equipment selection process, establishes standards or gives final approval in 95% of the cases surveyed. The remaining selections are in the hands of divisional IS or handled through some joint committee.
- Divisional IS clearly takes a dominant position in establishing technical requirements for the C/S platform and frequently participates actively in the selection process, even when managed by central IS.

c. The Role of Users

The role of user management and staff is tightly coupled with that of divisional IS, as shown in Exhibit III-7

Exhibit III-7

The Role of User Management in Platform Selection



As with divisional IS, users are directly involved in the selection process in more than half the cases. Users actually made the technology selections for a small percentage of the sample (6%), but their primary role is establishing requirements. And, while the

bulk of these are applications requirements, survey responses indicate that users are frequently involved in specifying some technical aspects of C/S computing platforms, including selection of:

- GUIs (Graphical User Interfaces)
- Personal productivity software, such as word processors, project management systems and spreadsheets
- Groupware environments such as Lotus Notes

d. Summary

Overall, IS plays the dominant role in the actual C/S platform selection and is the key player in managing the selection process in most situations. Nevertheless, in the case of C/S platforms, users and user IS staff play a significant role in terms of requirements, with users focused on applications and user IS staff functioning as intermediaries.

Quite clearly, most selections are through a team approach, where all three organizations participate under the general leadership of corporate IS. Vendor and general consultants do not play a significant role today, but probably will as they evolve more products and service offerings targeted specifically to C/S solutions.

B
C/S Platform Futures

Survey respondents did not anticipate major changes in C/S platform architecture over the next two to three years. The data indicates that anticipated changes in technology will be evolutionary. However, companies anticipated significant growth rates in terms of numbers of installed platforms over the next five years.

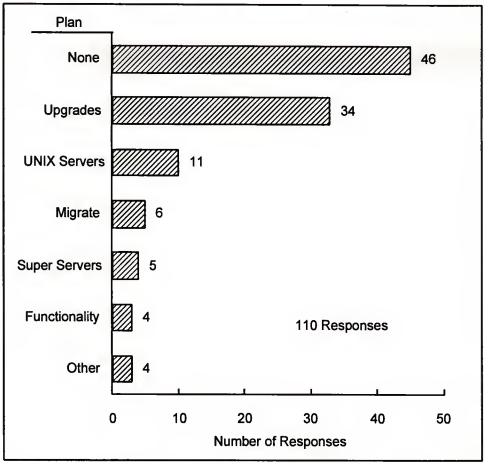
Assuming these trends are indicative of most company strategies, INPUT anticipates the installed base of platform combinations identified through this study are likely to become *de facto* standards as the installed base grows.

1. Directions in Hardware and Software

As shown in Exhibit III-8, 46% of the respondents indicated there were no immediate plans for changes in the server platform nor anticipated any changes made would be in the form of upgrades.

Exhibit III-8

Future Plans for Servers



Of those planning upgrades in the next few months, 80% referenced machines based on Intel's Pentium processor as the targeted server platform. Users are unable to decide whether to stay with platforms based on Intel's family of processors (i.e., 486, Pentium, P6) or jump to another platform long-term. Server upgrade strategies over the next few years are characterized by a "wait and see" attitude.

Most organizations recognize a DOS-based 486 class server will not stand up to processing and integrity requirements to run multiple applications from individual servers. Two alternatives that will be considered by most organizations are:

- To ride with Intel-based architecture by moving up to Pentium and betting that NT or Chicago (Windows 4) will provide the robust operating system environment required
- To change the underlying architecture to a RISC-based server with some type of UNIX operating system

The first approach seems safer and cheaper, but given the recent arrival of Pentium and unproven status of NT in the field, this combination may not be best. Going the RISC route is perceived as more costly by most companies (even though it probably is not, once system development, user productivity and support costs are considered). For those companies with significant investments in Intel-based technology, it would require significant additional investments in training and software.

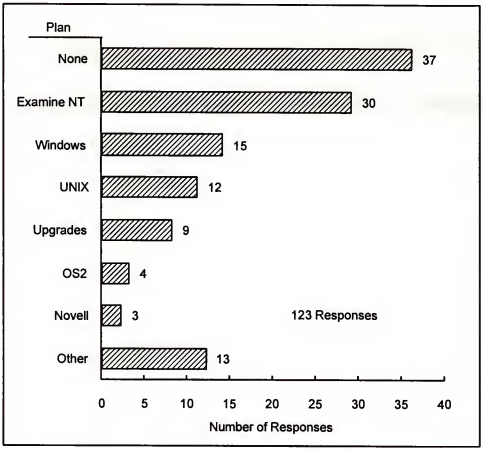
Nevertheless, conversion to equipment specifically designed to support UNIX server environments was cited as a future direction for about 10% of the respondents. In all instances, the switch will be from Intel-based servers.

A major unknown is to what extent UNIX, on Intel-based platforms, will successfully compete with Windows NT in the PC-LAN environment.

Exhibit III-9 shows 35% of companies considering a future change in operating systems have specific plans to pilot, or in some other way, examine NT/Windows.

Exhibit III-9

Future Plans - Client/Server and Network Operating Systems



Five companies are considering replacing UNIX servers with Windows NT servers to increase their choice of applications software. All four respondents who indicated that they would run OS/2, intend to run Windows applications.

To some extent, the survey's picture of the future projects current architectural commitments:

- Migrate away from mainframe servers wherever possible
- Increase NetWare use for local network communications
- Support Windows as the primary client applications interface
- Explore and implement UNIX-based server environments

INPUT believes UNIX will continue to be successful on high-end servers that replace some mainframe functionality, and NT will be successful on servers added to LANs with Windows clients. UNIX-based communications servers will have success until Windows NT can support the variety of protocols required in the average corporate computer center.

Another issue that could impact NT penetration is Microsoft's ongoing battle with Novell. At least 15 respondents committed to Novell as the primary network management system expressed concern about whether NT will coexist peacefully with NetWare. Much depends on how the successor to Ray Noorda, Novell's CEO for the last 10 years, reshapes Novell's marketing strategy.

Issues determining NT's impact on the C/S platform environment will most likely be resolved within the next year, as some pioneering firms install Pentium/NT-based servers for pilot or production C/S systems. Until then, most companies are unlikely to make any major deviations from their current commitments.

As a final note, some respondents commented on their intent to examine super-servers of one kind or another over the next few years. The primary interest appears to be in that class of machines currently labeled massively parallel processors. At the moment, however, none indicated any specific implementation plans for this type of server platform.

2. Platform Growth

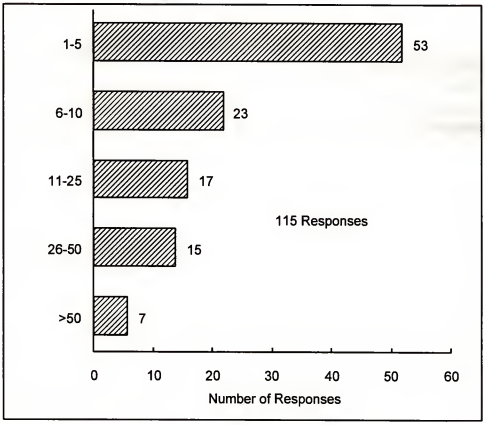
While respondents were conservative about significant future architectural changes, they certainly indicated that growth in the number of C/S platforms installed over the next five years would be dramatic.

a. 1993 C/S Installed Base

Exhibit III-10 shows the 1993 planned installed population of servers for the sample, broken down into five categories.

Exhibit III-10

Distribution of Number of Servers by Category - 1993



The average number of servers per respondent company for 1993 is 24, but distribution is not even. More than 80% of the sample will have less than average. The sample median is 10 servers.

This high degree of skew to the distribution is explained by these factors:

- Approximately 60% of the companies surveyed were either engaged in production pilots or in the early stages of C/S implementation. These firms dominated the 1-5 and 6-10 categories, weighting the average toward the low end. Furthermore, companies with full-scale applications underway that were using mainframes as servers, also skewed the distribution to the low end.

- At least 10% of the sample was fully committed to enterprise-wide use of C/S technology and reported extremely large numbers of servers per company, thereby pulling up the average. Examples of these firms include:
  - A major airline
  - Two major banks
  - A major power utility

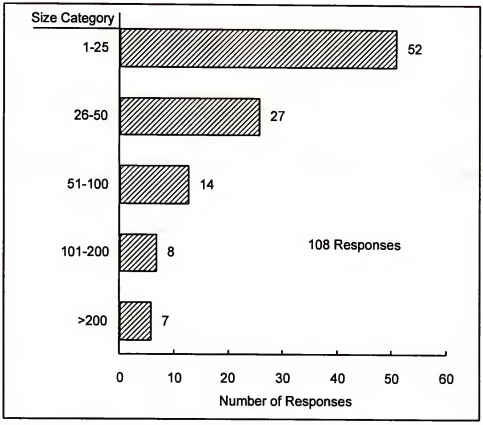
On the surface, one would expect the number of servers to vary significantly on the basis of company size. However, a tabulation of the server size categories against company size does not show significant results. This could be due to certain influences:

- Large companies just beginning to implement C/S applications would likely have only a small number of servers installed
- Smaller companies well along in implementation may have large numbers installed
- Large companies using mainframes will almost always have less than five servers, even for enterprise-wide applications

Additional insight into the nature of the sample's installed based comes from examining the ratio of clients to servers. Exhibit III-11 shows for most installations, the number of clients per server will be 25 or less.

Exhibit III-11

Distribution of the Ratio of Clients to Servers - 1993



For the total sample, the average number of clients per company in 1993 was approximately 1,300 and the median was 175. The count of client systems per firm shows wide variation based on stage of implementation and nature of the server, and has no significant correlation to company size.

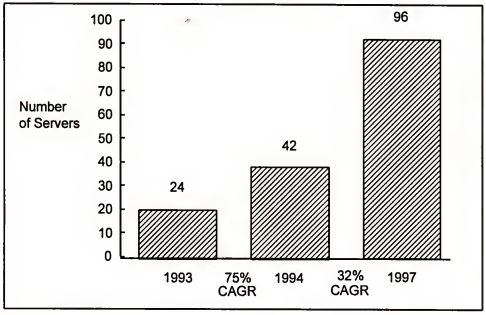
Approximately 75% of the respondents target a ratio of 50 or less clients per server. This ratio is typical of firms using workstations and high-end PCs as servers. Firms planning on using mainframes or minicomputers, such as AS/400s or VAXs, anticipate higher ratios of clients to servers with 12 of the 16 companies listing mainframes as servers anticipating ratios of 100 or more clients per server.

b. 1994-1997 Growth in Installed C/S Platform Base

As shown in Exhibit III-12, respondents plan extensive growth in the number of servers over the next five years, almost doubling in 1994 from the current average per company of 24 to 42 and growing at a CAGR in excess of 30% from 1994 to 1997.

Exhibit III-12

Average Number of Servers Per Company
1993-1997



The forecast clearly supports the concept that most firms are just beginning full-fledged implementations of C/S computing. Some implications are:

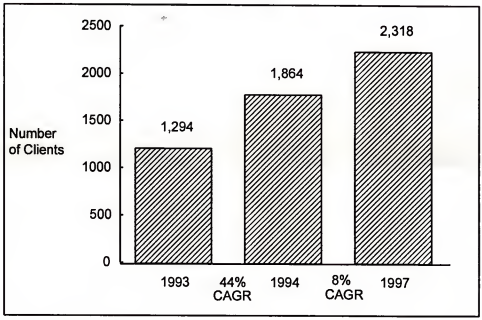
- The fact that most firms do not have plans to change platform selections in the immediate future, coupled with forecasted rapid growth, means the installed base of currently selected platform components will grow significantly in the next two to three years. As a result, vendors proposing alternate technologies will find it increasingly difficult to justify displacement of the existing infrastructure.

- This inertia will cause most companies to find logical extensions and improvements in their installed technologies for upgrades to features and functions, rather than consider a total displacement of the installed base.

As shown in Exhibit III-13 forecasted growth rates in the average number of clients is also significant. However, the growth curve shows a lower growth rate in future years for servers.

Exhibit III-13

Average Number of Clients Per Company
1993-1997



For clients, the 1993-1994 growth rate is 44%, compared to 75% for servers, and only 8% compared to 32% for servers in the 1994-1997 period.

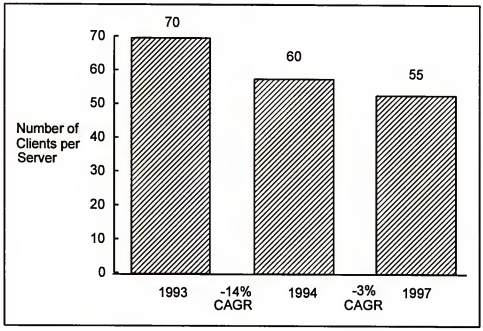
This difference in growth results from a variety of factors:

- Few users require a new PC or workstation. The above chart does not reflect upgrades and replacements for existing systems.
- Many firms already have PCs on every desk. By the middle of the forecast period, the ratio of client systems to employees will reach 1:1, or saturation, for many companies.
- Demands on server capacity will most likely grow at a more rapid rate than capacity requirements on the client side. At present, most companies plan to support multiple applications with servers. However, most companies are also in the early implementation stages of C/S computing, so may only have one or two applications actually implemented. As more are added, more and higher capacity servers will be required to meet multiprocessing requirements.

This last point is supported by survey data that shows most firms anticipate the ratio of clients to servers will actually drop over the 1993 to 1997 time frame, as shown in Exhibit III-14. It is worth noting that users do not perceive the need for multiple PCs at an employee's desk, which may become essential for highly productive individuals. In some cases, they may also underestimate the extent to which upgrades and replacements will be needed.

Exhibit III-14

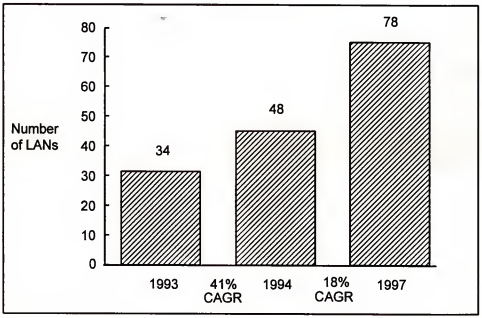
Forecasted Changes in the Ratio of Clients to Servers 1993-1997



As shown in Exhibit III-15, respondents predicted the LAN growth rate to be somewhere between the growth rates for clients (see Exhibit III-13) and servers (see Exhibit III-12).

Exhibit III-15

Average Number of LANs Per Company
1993-1997



As is the case with both clients and servers, 1993 to 1994 shows the highest growth rate for the 1993-1997 period--another indication that significant amounts of the C/S infrastructure will be put into place in the near term.

In general, respondents were less confident in their projection of LAN installations. Many believed there would be some significant changes in communications technology that might radically change the ratio of clients to LAN, etc. Others indicated they did not have adequate information to judge how transaction volume, brought on by new C/S applications, would impact LAN requirements.

Overall, most companies believe the ratio of clients to LANs will run in the range of 40 to 1 throughout the early part of the planning period, and might reduce to 30 to 1 late in the period as transaction volumes, brought on by new applications, grow.

c. Summary—C/S Platform Growth

One of the most significant study findings is the rapid growth anticipated for C/S infrastructure. Furthermore, the bulk of this growth in hardware and communications platform components will soon occur. In other words, respondents' current selections for hardware and basic operating systems technologies will rapidly populate corporations already in implementation. In effect, early adopters of C/S computing are not waiting to see how NT performs or how other issues involving open systems become resolved before moving forward.

Given the responses, to a large degree C/S platforms are likely to be dominated in the immediate future by Intel-based architectures running DOS, and eventually NT operating environments. Obviously, more options remain open on database and applications development strategies. However, to some extent, backing off from current selections will be an expensive process. Many firms have not yet committed to a C/S strategy, much less a preference for a technology platform. Nevertheless, implications for vendors are quite clear:

- Assuming reasonably successful implementations, early adopters will establish certain technologies as *de facto* standards.
- As the installed base grows, it will become increasingly difficult for anything other than revolutionary technologies to displace it.
- Those who have not yet selected a C/S platform strategy will be watching the pioneers closely.

Analysis of Client/Server Platform Components

This chapter presents a detailed analysis of the various components of the C/S platform:

- Section A analyzes equipment components for both clients and servers, including reasons for selection and vendor preferences
- Section B focuses on operating systems software preferences for clients and servers
- Section C centers on the software chosen for the network operating environment
- Sections D and E examine database management, development tools and applications development software that will be used

A
Equipment

Respondents identified well more than 150 specific types of equipment for either the client or server component of the targeted platform. For purposes of analysis, responses were classified into four categories: mainframe, minicomputer, workstation and PC. Appendix A provides INPUT's definition for each category. However, it should be pointed out that for purposes of this report, the terms "PC" and "PC-based" refer primarily to Intel-based platforms. Apple was mentioned by only three respondents.

1. Breakdown by Type of Equipment

Exhibits IV-1 and IV-2 show the proportion of each class of equipment, by number of respondents, that will be used for servers and clients, respectively.

Exhibit IV-1

Distribution of Server Equipment Platforms by Class

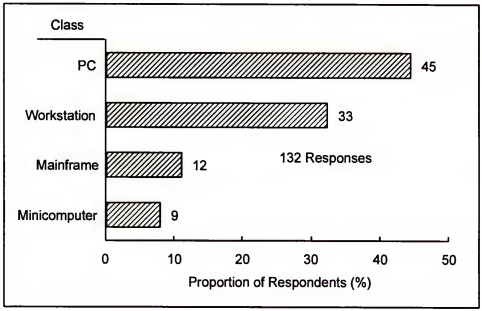
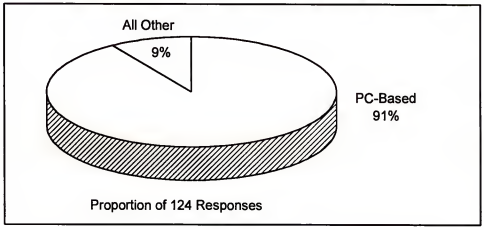


Exhibit IV-2

Distribution of Client Hardware Platforms By Class



PCs and workstations clearly dominate the server platform, representing 78% of the planned equipment choices. This is somewhat surprising, given the number of legacy systems that predominantly reside on mainframes and minicomputers. Further analysis of the data indicates:

- At least nine respondents plan to use mainframes as "super" servers in a three-tiered architecture where the mainframe will act as a distributor of data "in bulk" to servers in the network. These servers will interact directly with clients for the major portion of the processing.

- Approximately 60% are implementing new or completely re-engineered applications. In these cases, mainframes are clearly not the platform of choice.

The results of the survey clearly confirm a commitment to personal computers as the primary client platform equipment. Of the 9% of respondents that are not planning to use PCs, one will use minicomputers and the remainder will use workstations.

2. Reasons for Selection

Overall, 118 respondents provided information on their reasons for making client and server equipment selections. The unstructured responses were coded into the following categories:

- *In Place*—Installed equipment (or additional equipment of the type already installed) will be used for C/S applications.

- *Proprietary*—Selection was made because of proprietary characteristics of the equipment that were unique to the company or required for the planned applications.

- *UNIX*—Selection was made because of the equipment's ability to support a robust UNIX operating environment.

- *Price Performance*—Selection was made because the equipment will provide the necessary capacity at the lowest price.

- *Standards*—Required capabilities can be obtained using existing company standards of hardware, etc. (Standards could include specification of an architecture, such as Intel 486, or may actually dictate the specific configuration to be purchased.)

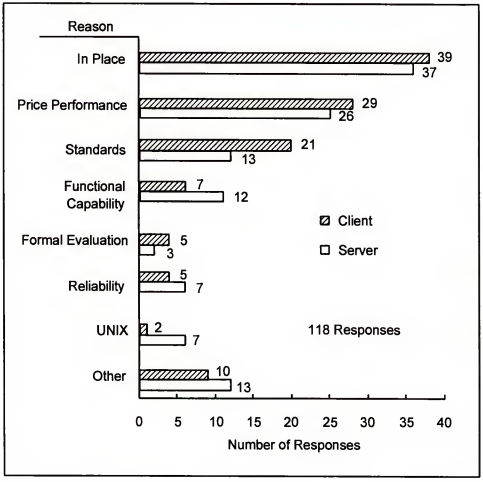
- *Functional Capabilities*—Features and functions required to meet connectivity, capacity or applications requirements.

- *Reliability*—Low mean time between failures or overall stability.
- *Formal Evaluation*—This classification was used for all responses where no specific reason was given, but results of a formal evaluation were cited as the mechanism in making the decision.
- *Other*—Included such items as vendor reputation, compatibility with existing network or operating systems environments, etc.

A comparison of the reasons for selecting client and server equipment is shown in Exhibit IV-3.

Exhibit IV-3

Reasons for Selecting Client and Server Equipment



The distribution of responses provides some insight into how companies view the C/S equipment selection process. In more than 40% of the cases for servers and 50% for clients, respondents will build on what's already in place or will select based on company standards. A detailed examination of individual responses indicates the tendency to "go with what they know" is strongly influenced by underlying factors:

- Investment in the installed equipment base is significant. Many firms indicated that any consideration of a total changeover to a new equipment platform would make implementation financially impractical.

- About 20% of the respondents mentioned difficulty of dealing with a heterogeneous environment as a major reason for staying with existing platforms:

  - Few companies are committed to total migration to C/S computing. Isolating a new or re-engineered C/S application on a totally different set of hardware platforms increases both complexity and cost of creating data and network links between the C/S environment and the legacy systems that remain on existing mainframes or minicomputers.

  - Most companies have already invested heavily in development of in-house professional resources to support existing environments. Many respondents believed any significant investment in new technical training to support C/S would best be spent on the applications side, rather than trying to retrain existing staff and users on new equipment.

- Twenty respondents also cited heavy investments already made in training users to be both comfortable and productive using interfaces such as Windows on existing desktop platforms. Unless dictated by application requirements, respondents see no benefit in attempting to retrain users to some new interface.

In cases where existing equipment or standards were not the primary selection criteria, price performance was. Survey respondents pointed out that over time, there are likely to be large numbers of servers and clients throughout their organizations. Even relatively minor variations in price can have a significant impact on overall costs.

The only reason for selection where there was a significant difference between clients and servers was in the case of standards. Only 8% cited standards as a primary reason for selecting servers, compared to 18% for clients. This is probably because most firms intend to use their existing PCs for client equipment. In many firms, standards for these have been established for some time.

There seems to be little response variation on equipment selection based on the size of the company or the number of currently installed servers and clients. Cross-tabulation of the reason for selection against these factors yields two significant observations:

- In all 16 cases where the mainframe was indicated as the server, it was picked because it was already in place.
- As might be expected, 14 of the 16 cases targeting mainframe servers come from firms whose annual sales are greater than $1 billion.

Analysis of the data related to equipment selection leads to these conclusions:

- Most firms undertaking new C/S implementations apparently see few limitations to using equipment already in place.
- If new equipment is to be selected, price performance will be the fundamental criteria unless the planned applications have technical requirements that dictate a more costly selection.
- Mainframes will probably not be selected as server equipment platforms unless they are already in place or sheer transaction volumes dictate.

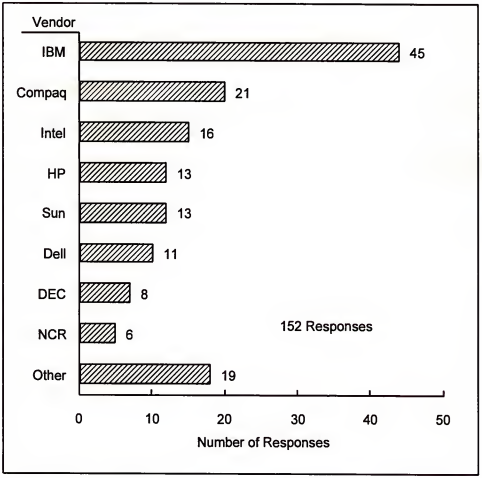
Overall, respondents appear to take a conservative approach to selecting both client and server equipment platforms, using whatever is installed, functional and conserving resources for the more challenging task of migrating applications.

3. Vendor Preferences

As shown in Exhibit IV-4, the fact that users rely heavily on their installed equipment platforms for servers is strongly reflected in their choice of vendors. Heavy commitment to IBM, HP, Sun Microsystems and processors (including those from NCR, Compaq and Dell), based on Intel architecture, reflects the installed base.

Exhibit IV-4

Distribution of Server Equipment Vendors



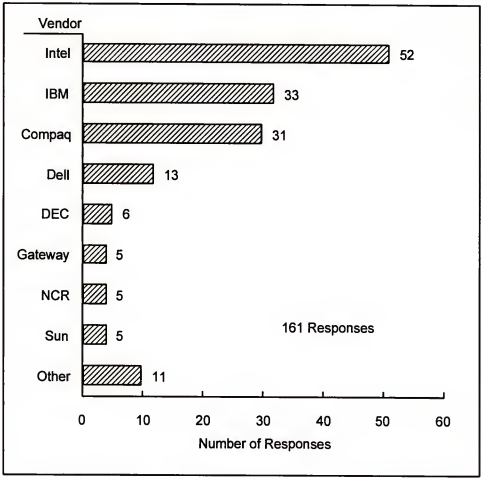
If Compaq, Dell and NCR are included with the Intel machines, then at least 54 (approximately 35% of 152) respondents will use Intel-based servers. Some of the IBM servers were also Intel-based.

- Servers will carry the IBM logo in about 30% of the cases, representing all but three of the 16 mainframe servers in the sample. IBM is also well represented in the server category with eight implementations that will use AS/400s and 10 RS/6000 platforms. The remainder of IBM server implementations will use PS/2s, mostly Model 95.
- Sun Microsystems, HP and the IBM RS/6000s make up approximately one-third of the total server workstation population. The remainder will be primarily DEC and NCR, although Sequent and Pyramid were mentioned as well.

Exhibit IV-5 shows Intel-based PCs will dominate the client implementations in well more than 80% of all implementations.

Exhibit IV-5

Distribution of Client Equipment Vendors



Note: In the case of both servers and clients, many respondents simply indicated they would use Intel-based equipment rather than mention a specific hardware vendor whose equipment uses Intel processors. This reflects the following:

- Intel's "Intel Inside" brand advertising has heightened user awareness of Intel as a vendor. The value of brand advertising cannot be underestimated and Intel-based vendors need promote their own brand names among users if they are to build a loyal installed base.
- Users will continue to select multiple vendors of Intel-based computers.

- With the exception of Compaq and Dell, Intel-based manufacturers do not have clear market positions in the minds of buyers.

A cross-tabulation of the top five vendors against reasons for selection, provides additional insight. The vendors included in the cross-tabulation were: IBM, Compaq, HP, Sun and the generic Intel category. Results for HP and Sun, grouped together to achieve a larger sample size, rated about equally in each category. Reasons for selection were grouped into the following categories:

- In Place or a Company Standard
- Capabilities and/or UNIX
- Price Performance/Reliability

The total weighting percentage for each vendor in each category was then computed. Results of the cross-tabulation for servers is shown in Exhibit IV-6. The last column of the table shows the total weighting percentage for each vendor or vendor group by the three categories.

Exhibit IV-6

Leading Server Equipment Vendors–Reasons for Selection

Vendor	% Weighting of Selection Criteria: In Place Standards	Capabilities (Inc. UNIX)	P/P* Reliability	% Other Factors
IBM	**61**	13	13	13
Compaq	**40**	13	**40**	7
Sun/HP	32	26	**42**	0
Intel	29	7	**36**	19

*Price/Performance

The results give testimony to the importance of IBM's installed base as a key factor in maintaining a strong position in the server hardware environment. Compaq also does well in this category because it has established a brand image with user organizations. Compaq really shines, along with the more traditional workstation equipment manufacturers, as a good price performer and producer of reliable equipment.

A similar analysis of data for client equipment indicates that IBM's and Compaq's weightings go up to 65% and 57% respectively in the "in place/standards" category. HP and Sun are selected most frequently as clients, because they meet specific functional or price performance requirements. In most of these instances, the applications are specialized engineering or banking and finance applications associated with trading.

The survey data indicates most companies plan to stay with their existing platforms and, to a large degree, vendors. That position is enforced by a general belief that:

- Capabilities provided by those equipment platforms are adequate, at least presently, to deal with planned application requirements.
- Staying will minimize the cost of migrating to C/S from a hardware viewpoint.
- Staying will reduce migration costs associated with retraining both technical and user staff.

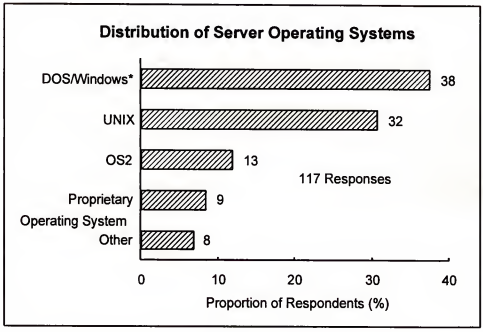
Furthermore, with limited exceptions, most companies do not have plans or formal evaluations in place that are likely to cause them to make a major equipment platform change in the immediate future.

B
Operating Systems

1. Servers

DOS and UNIX will dominate the target operating system environments for servers, as shown in Exhibit IV-7, representing 70% of the sample.

Exhibit IV-7



* Includes responses for DOS alone, as well as DOS with Windows. Windows will reside on 13% of server platforms.

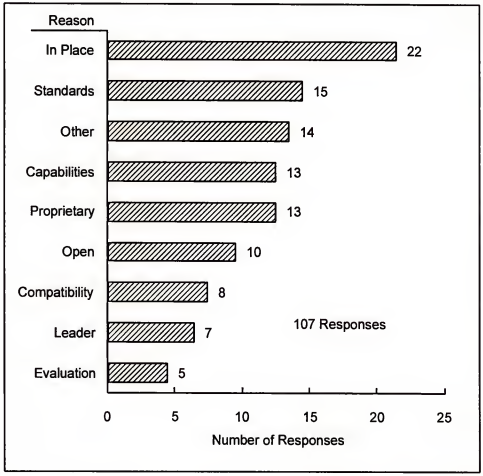
The distribution largely reflects the tight link between hardware architectures and their native operating systems. However, a tabulation of operating systems against platform type shows that, in a number of instances, companies will move toward UNIX-operating environments on what would traditionally be considered non-UNIX hardware platforms.

- Approximately 80% of the Intel-based platforms will use DOS. The remainder will be divided primarily between UNIX or OS/2.
- More than 85% of workstation servers will use UNIX, with the remainder split between DOS and some proprietary environment.
- Of the minicomputers that will function as servers, approximately half will use a UNIX operating environment and the remainder their native operating systems.

Exhibit IV-8 indicates that companies' selection criteria for server operating systems place somewhat less emphasis on the "in place" or company "standards" criteria than in the case of equipment. These two categories account for only 34% of the responses for server operating systems, as compared to 42% for server equipment.

Exhibit IV-8

Reasons for Selecting Server Operating System



Excluding the "in-place" and "standards" categories, no particular selection factor stands out. The number of factors looked at, as well as complexity of making comparisons, goes up dramatically for the selection of operating systems as opposed to equipment.

For example, the most significant criterion for equipment selection, beyond the fact that the equipment was already in place, was price performance. Price performance was barely mentioned for server

operating systems software, showing up only twice in the "other" category. No category dominates the operating systems selection list.

On the other hand, under headings of "capabilities" and "compatibility," respondents cite a variety of significant requirements for server operating systems software. For the "capabilities" category, respondents placed heavy emphasis on:

- The ability to run or simulate multitasking environments
- Performance analysis and tuning tools
- Diagnostic and control capabilities
- Scalability to meet different capacity situations

Key areas where respondents looked for compatibility included:

- Interfaces with network management systems
- Support for critical database management or specific applications software
- Enough compatibility with operating systems hosting legacy applications to support migration requirements
- Interoperability with proposed client environments

If these are the requirements, then why pick DOS? Clearly, DOS misses the mark in comparison to other choices when it comes to such capabilities as multitasking, performance analysis, tuning tools and scalability. Although 13 respondents picked DOS because it was in place and five selected it because it was a corporate standard, there are still 20 firms that selected DOS as the primary server operating system.

Trading off some of the capabilities requirements offered by other operating systems for compatibility is a prudent buyer strategy, at least in the short term. For example:

- DOS was picked by five of the seven companies that cited industry leadership as a significant selection criterion.
- More than half of those citing compatibility also picked DOS.

- About 33% of those selecting DOS said that they did so because there was no other *de facto* standard. At least half of them were planning to evaluate Windows NT. They stated they would remain with DOS until a clear market leader appeared.

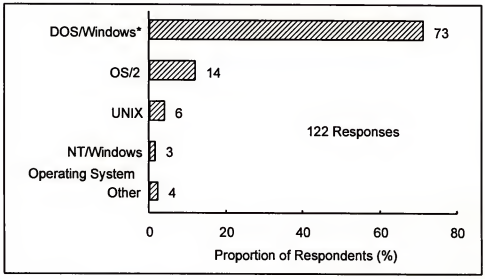
It appears that DOS will remain a dominant factor in the server operating systems environment for some time, even though it fails the test in terms of several desirable capabilities. Despite the fact that UNIX and OS/2 have many desired technical characteristics for a server operating system, they are not likely to overtake the DOS position in the near term.

2. Clients

As shown in Exhibit IV-9, the situation for targeted client operating systems is much more clear-cut.

Exhibit IV-9

Distribution of Client Operating Systems



* Includes responses for DOS alone, as well as DOS with Windows. Windows will reside on 85% of the DOS client platforms.

DOS, with or without Windows, is clearly the dominant target, with UNIX playing a significantly less important role in the client environment than it does with servers. As with servers, the high use of DOS is totally consistent with the Intel equipment platform targeted for 90% of the companies surveyed.

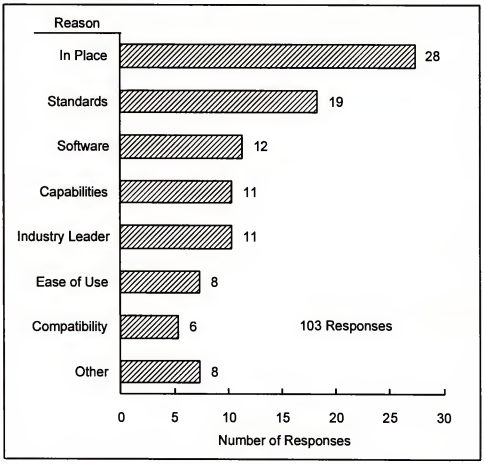
- Most companies using OS/2 for the client operating system environment were larger institutions where OS/2 had been selected as a standard or was already in place as the result of commitment to IBM's LU 6.2 standard for cooperative processing.

- Situations where UNIX platforms were selected as the client operating system were dominated by engineering applications requirements.

The complete tabulation of the reasons for selecting the client operating system, as shown in Exhibit IV-10, shows again the strong tendency to stay with what is in place, with 46% indicating that "in place" or "standards" were the dominant criteria in the selection process.

Exhibit IV-10

Reasons for Selecting Client Operating System



As with server operating systems, criteria other than "in place" and "standards", reflects a diversity of requirements, with no single one clearly dominating the selection process. However, some new criteria appears that reflects a difference in the way client operating systems software is selected. For example:

- *Software availability* ranks third in the selection criteria. Respondents plan to use significant amounts of packaged applications and applications enabling software on clients. In fact, 11 of the 12 companies selecting DOS/Windows did so because of the availability of software for Windows.

- *Ease of Use* also surfaces as a selection criterion for client operating environments, and reflects a strong interest on the part of designers and implementors to minimize user training. All eight companies that listed "ease of use" as the primary selection criteria picked DOS/Windows as the client operating environment.

As with server operating systems, industry leadership plays a role in the selection of client operating environments. Ten of the eleven companies that listed industry leadership as the primary criterion selected DOS/Windows.

Analysis clearly indicates that when selecting the client operating environment, companies place a heavy emphasis on their existing investment in Intel-based PCs and associated software and training. As the penetration of Windows into this environment continues to grow (whether for C/S implementations or not), services firms and third-party software developers must make Windows a primary target for their offerings.

While some experts may not find DOS/Windows the most elegant selection, it is the dominant environment on the client side for the foreseeable future. Until some clearly superior alternative with ease of migration characteristics becomes available, the installed base will be hard to displace.

3. The Impact of Windows

From a purely technical viewpoint, DOS/Windows does not constitute an operating system, DOS being the operating system component of the overall DOS/Windows operating environment. Therefore, throughout this study, INPUT has been careful to note

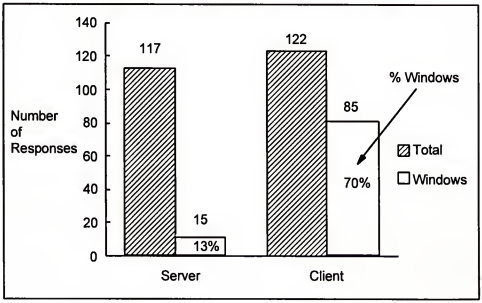
when responses indicating DOS and those referring to DOS/Windows environments were bundled together for analysis purposes.

Nevertheless, from the users and many systems professionals point of view , the two constitute a single applications development and operating environment. There is little doubt that if Windows did not exist, DOS would still play a significant role, particularly on the client side, by virtue of its installed base and Microsoft's commitment to its future enhancement. However, whether it would have captured and maintained the dominant position on the client side without Windows is debatable. Without Windows, Microsoft would certainly be vulnerable to X-Windows, Motif and other possible selections.

The data presented in Exhibit IV-11 clearly indicates that impact of Windows on the client side of the C/S paradigm.

Exhibit IV-11

Use of Windows by Clients and Servers



Considering that the client population includes all clients (UNIX, OS/2 and other), the 70% planned penetration of Windows for client environments is significant. In fact, a number of respondents who selected OS/2 for the client operating system indicated that one of its virtues is that it would run Windows. Other survey data indicates that in at least 15 instances, either pure OS/2 users or

respondents who selected DOS (standalone) as their client operating system, are evaluating the addition of Windows.

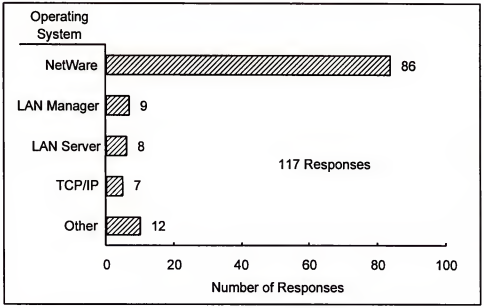
At present, Windows plays a significant role in shaping the future installed base for client platforms. Assuming Microsoft continues to move the product forward on new DOS and NT operating system platforms, it will be increasingly difficult for vendors, with client-side offerings, to ignore the environment as the richest opportunity for new applications enabling and applications software products.

C
Network Operating Systems

If there is anything more pervasive than the penetration of Windows on the client side of the operating environment, it is the dominance of NetWare as the network operating system of choice. As shown in Exhibit IV-12, 73% target Novell's product as their primary networking package.

Exhibit IV-12

Distribution of Network Operating Systems



NetWare does vary as a function of server equipment.

- Where mainframes are the primary server equipment platform, 88% of installations will use NetWare. This heavy penetration is because NetWare offers one of the only alternatives to provide connectivity between the traditional IBM environment and the wide variety of non-IBM client equipment platforms likely to be found on the client side.

- NetWare will be used in 71% of the cases where PCs are the primary server platform. The fact that this penetration is lower than for mainframe environments is due, largely, to the fact that more alternatives, such as LAN Manager, exist for PC-to-PC communications.

- The lowest penetration (55%) occurs in the case of minicomputer servers, where a high concentration of DEC equipment leads to a heavier use of DECnet.

Overall, the more heterogeneous the environment, the more frequently NetWare is likely to be selected. This conclusion is reinforced by the high rankings that respondents give "capabilities" and "compatibility" as reasons for selection. (See Exhibit IV-13.)

Of the respondents indicating these two categories as primary reasons for selection, more than 60% chose NetWare as the target network operating system, most frequently citing interoperability or compatibility with multiple operating systems as its key strengths.

NetWare's dominant position, reinforced by the fact that it has a large installed base, has already been adopted as a standard by many firms:

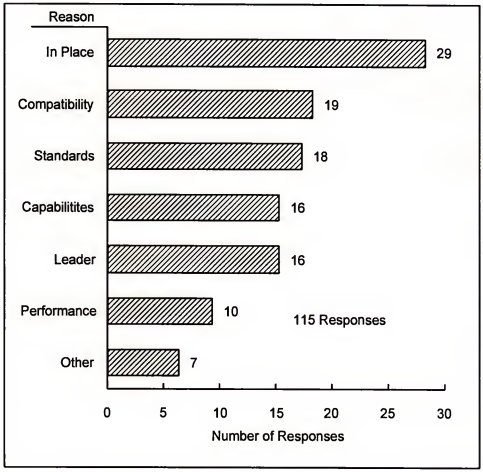
- 75% of the respondents who went with what was "in place"

- 72% who selected on the basis of existing standards

One hundred percent of the 16 respondents who cited industry reputation as the primary selection criterion picked NetWare.

Exhibit IV-13

Reasons for Selecting Network Operating System



D
Database Management Systems

Database management software may well be the most critical component of the C/S platform.

- It provides the primary interface with the applications environment. As such, its capabilities, ease of use and associated development tools will dictate the investment and elapsed time required to migrate existing or build new applications for the C/S environment, as well as with applications that can be ported to heterogeneous equipment platforms.

- Furthermore, the database management software's operating characteristics will, to a significant degree, determine the total equipment resource requirements and the level of integrity obtainable for processing business transactions.

Unfortunately, the selections are not obvious. What suffices for *ad hoc* workgroup computing, is not necessarily a viable solution for large-scale production or enterprise-wide applications. The traditional mainframe packages for these types of applications were not designed to support truly distributed environments.

The survey data indicates that companies struggle with making the choice. More than 25% believe they will have to support multiple database environments for extended periods to meet existing and planned application requirements.

1. Analysis of Database Strategy by Type of Database

Despite the difficult selection process, some trends seem to emerge. Exhibit IV-14 shows the proportion of targeted databases by type for servers and clients.

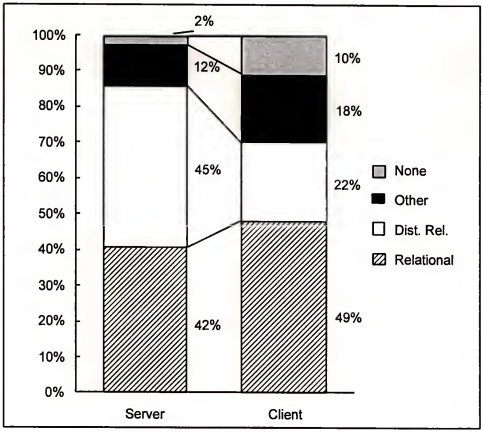
Clearly, the relational model has taken hold, with 87% of server platforms and 71% of the clients targeted for either single platform or distributed relational database environments. This penetration rate for relational is approximately 20% higher than INPUT's previous estimates.

The fact that clients show a lower proportion of distributed relational environments, 22% versus 45% for servers, does not mean data distribution will not be a key component of the planned application architecture. In fact, 55% of respondents plan to run the same database system on both clients and servers. In 80% of these cases, the database will be distributed relational. Further analysis indicates that in many instances where distributed relational is not on both sides of the C/S platform:

- A common SQL interface will be used to facilitate data distribution between the client and server platforms.
- Plans are to migrate the client side of the platform to distributed relational over time.

Exhibit IV-14

Proportion of Data Base Types–Servers and Clients



Only a small portion (10%) of the client population plans to operate without some type of off-the-shelf database software. Half this group will use some sort of proprietary database that is an integrated part of an application. Eighty percent of this group plans to evaluate some standard package as a replacement to existing proprietary database environments.

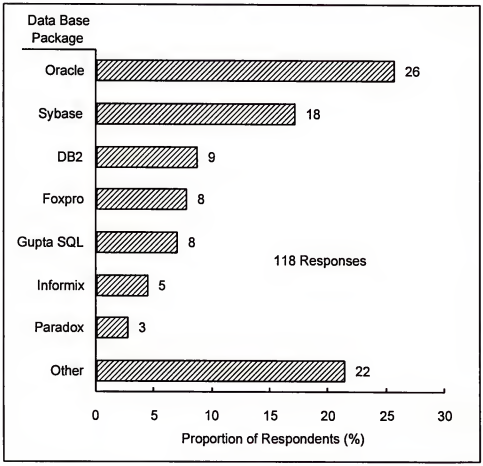
Based on respondents' future plans, the proportion of both servers and clients running a common distributed relational database system will continue to increase. However, nondistributed relational software systems will remain in place, particularly on clients, to support local processing. SQL will bridge relational databases on the client and server.

2. Servers

As shown in Exhibit IV-15, distributed relational systems, such as Oracle and Sybase, will be the primary database software for a significant group of companies surveyed. Together, these two systems represent 44% of the planned database software installations.

Exhibit IV-15

Distribution of Data Base Software–Servers



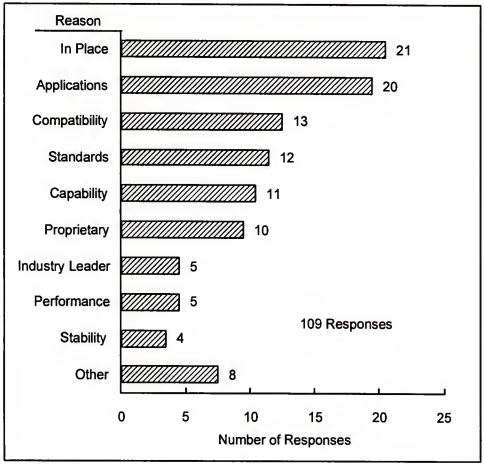
Furthermore, Sybase and Oracle appear to be the preferred systems for the high end of server equipment platforms that support enterprise-wide applications.

- Of the twelve mainframe servers identified in the survey, six will use DB2 and the remainder either Oracle or Sybase.
- Of the 33 workstation-based servers, Oracle and Sybase will be used in 27 instances.

Respondents expressed a variety of reasons for selecting particular database software products. As shown in Exhibit IV-16, environments "in place" or dictated by corporate standards, were primary selection reasons for 35% of the sample.

Exhibit IV-16

Reasons for Selecting Server Database System



The inertial effect of standards and installed base significantly influenced the hardware and software selections of hardware, operating system and network operating systems components. However, this is not the case for the database management component. Oracle and Sybase represent only 19% of the installed base of server database management systems. Yet they collectively represent 44% of the planned installations for servers, reflecting the growth these companies can expect. This indicates that for a significant number of companies, current data management systems will not meet their long-term requirements. This concept is further reinforced by heavy weighting that distributed relational

database systems achieved in the areas of "applications," "compatibility" and "capabilities."

- Availability of applications software packages is the second highest ranked factor influencing server database management software selection. Oracle ranked highest in this category.

- Where compatibility was the deciding factor, Oracle and Sybase account for 10 of the 13 respondents, and both systems were well represented in situations where general functional capabilities were the deciding factor.

- Where functional capabilities were the primary selection criteria, Oracle and Sybase accounted for seven of the eleven responses. (Interestingly, Foxpro accounted for three of the remaining four. In all three instances, ease of development was cited as the primary selection criterion.)

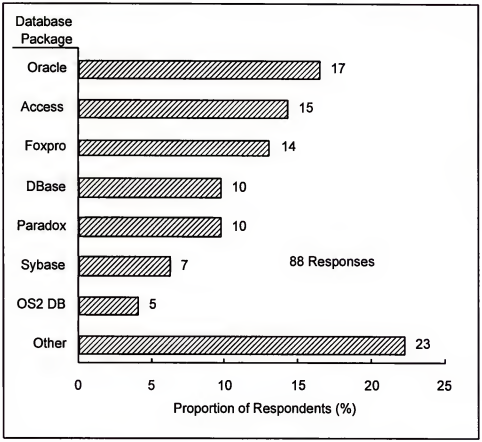
All of these factors indicate the migration to C/S computing causes a considerable amount of rethinking regarding database environments. The end-product is likely to accelerate the migration to distributed relational database management software.

3. Clients

The situation for client database software is not nearly as clear as it seems for servers. As shown in Exhibit IV-17, while Oracle ranks number one, it is currently planned for use by 17% of the clients. Sybase makes an even poorer showing with just six targeted installations.

Exhibit IV-17

Distribution of Database Software–Clients



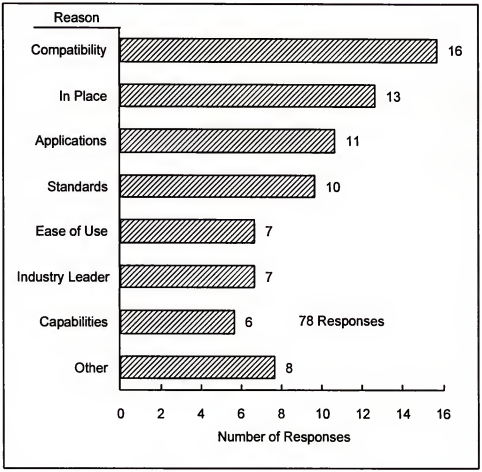
This large variety of packages could be the result of three situations:

- Less thought has been put into analyzing client requirements in the database area than for servers.
- Most companies plan to use existing PC installed bases for clients. As a result, the huge variety of database management software already installed on these PCs will become legacy.
- While planners would like to reduce the number of client database management systems they are required to support, considerable investments have already been made in thousands of applications that run on these packages.

Examining the reasons for selection, as shown in Exhibit IV-18, provides additional insight into why some packages appear and others do not.

Exhibit IV-18

Reasons for Selecting Client Database System



The first three categories account for slightly more than half the responses, and to some degree must be considered together to obtain a more accurate assessment of motivating factors for client database selection. Many were unclear which of the three were primary and 14 respondents, not tabulated in the exhibit, indicated they were still deciding. For example:

- Many respondents who said they selected on the basis of applications were clearly thinking of existing applications that run on the installed software, not the availability of outside packages.
- Others used the "in place" category because they had existing applications in place, not the fact that the in-place database platform was key to making the decision.

- Compatibility was used to describe compatibility with existing in-house applications as well as compatibility with targeted server database selections.

On the client database side of the equation, companies have a substantial legacy environment. Lacking any specific plan for how to deal with the environment, they tend to support multiple client databases for C/S computing until one of two things happen:

- A client database management system develops enough critical mass to be declared the winner.
- A "top down" strategy from the server side forces migration to one product or the other.

Despite this confusion, examining why specific database systems were selected provides additional insight:

- Oracle was picked primarily because of available applications and compatibility with the server database selection. At least two respondents cited Oracle as the industry leader.
- Virtually all respondents who selected dBase did so because it was in place or there was a heavy investment in existing applications and user training. Paradox was selected primarily for the same two reasons.
- OS/2 DB was picked because of "promised" compatibility with the IBM mainframe environment or because it comes bundled with the operating system.

The appearance of Access and Foxpro, immediately behind Oracle in the rankings, is somewhat of a surprise. Certainly Foxpro is an established product. As mentioned earlier, many users consider it one of the easiest relational DBMSs in which to develop applications. In fact, at least three respondents said they intend to use Foxpro as a development tool, porting the SQL code generated by the system to some other relational or distributed relational environment.

Access, on the other hand, was recently released; it has no track record or significant suite of applications products to recommend it. However, Microsoft 's promotional power is behind Access. For example, a runtime version of Access is currently bundled and shipped with the Visual Basic 3 Developers' Kit. A closer

examination of the reasons why companies in the sample have selected Foxpro and Access suggests users believe Microsoft ,over time, will provide a seamless integration of these systems with Excel, Word and other offerings under the Windows interface using OLE 2. There is support from the survey data:

- Of the companies that selected Access, industry leadership and compatibility with installed PC software and the DOS/Windows interface were the primary motivators for selecting Access.
- Of the 15 selecting Foxpro, at least 10 mentioned availability under Windows influenced the selection.

Even though the sample is too small to conclude that a Microsoft database product provides a distinct advantage, there are some clear indications that, at least for some companies, adopting a full suite of Microsoft products at the client desktop could become a popular approach. In fact, three respondents indicated Microsoft had been adopted as a standard for their desktop software environments. This is bad news for Borland, whose dBase and Paradox products are behind.

In summary, issues surrounding the selection of client database products for clients is a lot more chaotic than for servers. Yet, over time, the two will need to converge on common software or through tightly coupled interfaces if solid solutions, based on the C/S computing model, are to succeed. In the interim, users are likely to seek software vendors who can provide packaged solutions on the client side that will accommodate their PC legacy systems.

4. Database Selection Criteria

Respondents commented on a number of factors that influenced decision making about the database environment in general. Specifically, they rated (1 low to 5 high) the level of influence of each of the following:

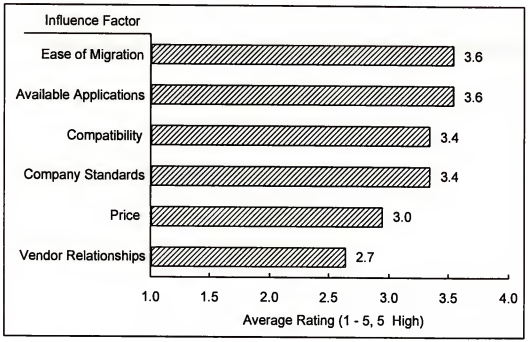
- Price
- Compatibility with current database management systems
- Ease of migration to the new database environment
- Relationships with existing vendors

- Corporate or divisional technology standards
- Availability of applications software

The averaging ratings are shown in Exhibit IV-19.

Exhibit IV-19

Rating of Factors Influencing Database Selection



Given the size of the sample, it is impossible to differentiate between the average ratings for the four leading factors. However, price and vendor relationships play a lesser role in determining the overall C/S database environment than they do in hardware and operating system selection, where the impact of price was rated at 3.5 and vendor relationships at 3.0. Reasons for these differences can probably be explained as follows:

- "Ease of migration" is higher for databases than for hardware and operating systems, because a key factor in database installation is data conversion.
- Hardware and operating systems are viewed as commodities, hence their price is a key distinguishing factor. Databases are less of a commodity, hence less sensitive to price.

- Although vendor relationships rank a low 2.7, if the database software vendor provides related services or installation support, the vendor relationship is likely to gain in importance. For example, respondents rated relationships with Oracle and Sybase, who undertake user consulting, at an average of 3.2.

Users who ranked interest in standards high also ranked the following factors higher than the sample:

- Ease of migration at 4.0
- Availability of applications at 4.2.
- Compatibility at 3.9

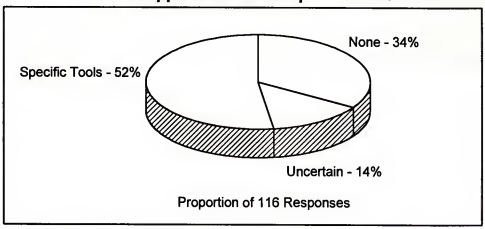
This shows that they are primarily interested in running applications that are compatible with their existing environment, rather than making massive investments in innovation.

E
Application Development Tools

Selecting applications development tools or CASE products is definitely the area where respondents seem least comfortable. As shown in Exhibit IV-20, just about half indicated they are still evaluating (uncertain) or do not intend to make a decision right now.

Exhibit IV-20

Use of Applications Development Tools



This shows they are primarily interested in running applications that are compatible with their existing environment, rather than making massive investments in innovation.

Of the 48% in the "none" category, just about half said they did some evaluation to determine what their strategy should be, but decided not to commit to a product for one of the following reasons:

- Available products to support C/S were unproven or lacked the functionality to justify their cost.
- Available tools would not support the combination of client and server platforms selected.
- The company, whose CASE tool they currently used, had not yet developed an acceptable offering to support C/S computing.

The remainder of those in the "none" category did not believe CASE tools were warranted at this stage, and were not likely to adopt any form of CASE as a strategy in the near future. Those in the "uncertain" category expressed some of the same concerns, but most indicated they were still studying the problem.

Fifty- two percent of the respondents who indicated they selected a development technology, did not identify any clear-cut leaders. Of the 60, 20 products or methodologies identified got only a single mention. The remaining 40, broken down by number of mentions, are shown in Exhibit IV-21.

Exhibit IV-21

Application Development Technologies
Two or More Mentions

Number of Mentions	*Product/Offering*
14	Powersoft Power Builder
6	Microsoft Visual Basic
4	Knowledge Ware Viewpoint
	Oracle CASE
3	C++, Gupta SQL
2	IEF, Microsoft Foxpro, Borland
	ObjectVision

A number of those in the "uncertain" category gave some indication of their likely direction. If these had been tabulated as actual choices, then Exhibit IV-21 would have shown: Power Builder at 19, Visual Basic at 10, Oracle CASE at 8 and Gupta SQL at 7.

Regardless of tabulation method, Power Builder from Powersoft was the package mentioned most. At present, it comes closest to providing the capabilities necessary to deal with both the server and client side of the implementation problem, at least on the database side. Assuming appropriate enhancements, it likely will remain a significant contender in the C/S CASE arena.

Products like Visual Basic and ObjectVision provide easy-to-use alternatives for the Windows-based client environment. Whether these tools help build heavy duty enterprise-wide solutions is an open question. If a simple user interface is required, they provide rapid applications development so users may program their own forms. If sophisticated features like conditional execution, high-speed PC data access and security are required, then they are inadequate. The C/S-oriented offerings from some of the traditional leaders in mainframe CASE, IEF and KnowledgeWare, are too new to analyze in detail.

The most likely scenario for the immediate future is that companies recognize the lack of a single integrated set of tools to deal with C/S design and implementation. They will typically :

- Select one architecture design tool, whether CASE tools or software libraries, that allocates processing and data management activities between servers and clients
- Translate that design into requirements for screen building, database architecture and processing
- In parallel with the above, use individual tools designed for specific software platforms to generate screens, build the database and generate code
- Iterate the above two steps until the design meets user performance and functional requirements

There are two situations where this approach will probably not be adopted:

- If a company picked a common database management system or cross-platform software generation tools for both the server and client, and the provider of that software offers applications development technology. Oracle is a good example of a company that provides both a database and supporting tools, such as Oracle CASE.
- If a company selected a major systems integrator, such as Andersen or EDS, that offered a "complete" methodology for re-engineering and new C/S implementations

Clearly over the long term, dominant technologies will evolve. For now, the great variety of heterogeneous platform environments, coupled with the lack of clear-cut C/S application design principals, allows most companies to choose from many offerings to meet their needs.

Buyer Issues

This chapter describes key buyer issues identified in the study and gives INPUT's interpretation of how they are addressed. Survey respondents discussed future directions and reasons for their choices of platform. Analysis of the logic supporting their selections provides insight into some of the issues buyers confront in the decision making process.

A
Business versus Technology Issues in the Selection Process

Every decision regarding the selection of a new computer architecture involves trade-offs between technology alternatives and practical business considerations. Striking a proper balance between these two is no different in the selection of C/S platform components than it would be for any other technology. Gaining the benefits of C/S computing will require:

- Shifting large-scale mainframe computing infrastructures to distributed networks
- Re-engineering existing applications
- Restructuring applications development

Respondents for this study were selected because they had already made the decision to migrate a significant portion of their applications to C/S technology. Their business environment has the following characteristics:

- A large installed base of technology and applications investments already in place
- Existing systems that present a feasible solution for the short term, but may not prove the best solution in the long run
- Integrated platform solutions, usually desirable over the long term, but not yet field proven or well enough accepted to be seriously considered as production environments by most sites
- Multiple vendors who provide client/server system components, so that relying on a single vendor's strategy is impractical and even potentially dangerous

Survey data suggests that companies, confronted with selecting a C/S platform in light of this environment, weigh the decision on the business side, leveraging their legacy platform environments until newer technologies become field proven.

This approach has the business advantages of:

- Extending the life of the investment in the installed base of equipment
- Reducing front-end training costs for technical support and systems engineers
- Allowing a window of opportunity for testing recently delivered or promised new technologies that will operate on existing platforms

Survey analysis provides data to support this position.

- Respondents rated compatibility with existing environments 4.2 on a scale of 1 to 5, and said it was the number one factor influencing the overall selection process. If, in their judgment, there were clearly superior and proven alternatives, they likely would have significantly invested in equipment and retraining to proceed in a totally new direction.
- Respondents' future plans for equipment and operating systems indicate that 80% will stick with existing architectures and migrate to higher levels of price performance and functionality through upgrades.

- For the 32% currently committed to DOS/Windows, some will explore UNIX on higher-powered servers. However, only three expressed a commitment to migrate in that direction. The remainder will compare that alternative to the more conservative business approach of thoroughly examining NT before making the larger hardware investment required for UNIX.

Results also indicate that whether business or technology factors dominate, the decision making process varies, depending on the platform component.

Exhibit V-1 shows the key business and technology issues for each component and indicates by "*" the issue that dominated the selection process for the majority of survey respondents.

Exhibit V-1

The Relative Importance of Business versus Technology Issues in C/S Platform Component Selection

C/S Component	Business Issues		Technology Issues	
Server Equipment	*	Large installed base expensive to replace, plus heavy investment in technical training, etc.		Capability of existing equipment to handle growing numbers of applications
Server Operating System	*	Heavy investment in training for changeover to new OS, particularly to UNIX.		Large DOS installed base does not have true multiprocessing capability, could be solved by NT, UNIX, OS/2
Client Equipment Operating System	*	Huge investment in installed PC base, Windows and associated user training		Potential capacity problems and current weaknesses in the DOS/Windows environments fault management
Network Operating System	*	Large installed base (NetWare), investment in training and technical support		NetWare considered state of the art, but there are concerns about integration with NT
DB Management Software		Significant investment to move to distributed relational, both training & licensing	*	Provides primary interface to applications and portability across multiple platforms
Applications Development Tools		Costly to outfit designers and developers with new tools, plus significant investment in current tools and training	*	Tools must match C/S applications architecture, critical to rapid development and re-engineering
(*) Indicates issue taking precedence in selection process				

Buyers who elected **existing applications** tell vendors that until they see significant proven benefits to migrating from their installed hardware and operating systems environments, they will take a conservative business approach to C/S platforms.

On the other hand, when it comes to **new and re-engineered applications**, most firms will let technology issues dominate the selection.

There are two important reasons why this makes sense:

- Many currently installed data management technologies, e.g., IBM's VSAM or Foxpro, do not support all of the following:
  - Distributed data management
  - User programmable access to data
  - Database integrity across multiple platforms, including mainframes
- For new applications, vendors can afford to experiment with new software typically distinguished by technical features.

Even though heavy investments will need to be made to reimplement existing applications to use these database environments, buyers will take risks and bear investment costs to get there. They hope to achieve:

- Relative independence from specific hardware or operating systems environments
- Reduced implementation time and lower maintenance costs

Buyers presently see little advantage to anything but sticking with current investments in equipment, operating systems and related technical expertise.

B
Impact of the Current Environment

The previous section touched on a number of aspects of the current environment that are key issues in selecting C/S platforms. This section explores the following three issues in depth:

- Limitations on current technology
- Impact of legacy architecture
- Impact of conversion

1. Limitations on Current Technology

Most limitations are with systems software meeting C/S platform design objectives. Most survey respondents were not concerned about hardware limitations. They generally believed that whatever they selected would meet immediate requirements, and through continued improvement and upgrades, future ones as well. But when it came to software, limitations ranged from capabilities of existing operating systems to availability of applications software.

A synopsis of concerns identified in the survey helps define the problem from the buyer's perspective.

a. C/S and Network Operating Systems

Why did users pick DOS as a server environment? From a buyer's point of view, there are a number of problems with the alternatives:

- *Windows/NT*—Assuming it meets expectations, Windows/NT solves the multiprocessing problems of DOS and has a number of advantages, including the common look and feel of Windows/DOS, built-in networking capabilities and the promise of being scalable to larger platforms to handle enterprise-wide solutions. But respondents also believe that NT's present problems and limitations can be resolved before it becomes a standard for either client or servers.
  - Because Windows NT is only partially "open" to integration of other systems software products, users are limited in their choice of network and systems management products to those from the Windows environment.

- NT competes directly in the network management arena with NetWare, the current network management software of choice.

- *UNIX*—With a much longer history of development, UNIX was specifically designed for peer-to-peer distributed networking, scalable to a variety of environments. UNIX works well in mixed-systems networks and is a primary platform for relational databases like Oracle and Sybase. There is even hope that a unified version might someday emerge through the COSE, OSF and X/Open distributed processing initiatives. Failing this, SunSoft may realize its vision of making Solaris the prime choice for UNIX users. However, the typical survey respondent cited significant limitations:

  - Too many variations of the system exist. Despite the efforts of standards groups and consortiums, confidence is low a single standard will emerge.

  - Proprietary systems (including partially open NT) have better system and resource management facilities.

  - Many NetWare and UNIX applications must run on separate servers, or at least separate disk partitions of the same server, to interoperate between their network operating systems.

  - The large installed base of Intel-based PCs do not provide the ideal hardware platform for UNIX.

- *NetWare*—The established industry leader—80% selected NetWare for network communications. Novell's commitment to openness stimulated a number of third-party applications vendors for managing hubs, routers and workstations to enhance NetWare's Services Manager capabilities. Nevertheless, respondents believe that some problems still exist.

  - Several respondents commented that NetWare is expensive compared to what they anticipate network management will cost under the solution bundled with NT.

- Novell must improve transaction processing support, as opposed to inquiry-based applications. NetWare 4.0 presumably will address this issue with a transaction journal feature and other improvements.

b. Database Management Systems

Systems like Oracle and Sybase have been optimized for, and are extremely effective in, supporting query-based business applications. However, when implementing high-volume transaction-oriented systems that focus on repetitively updating smaller amounts of data, they still are not as efficient or reliable as single-vendor solutions. In a client/server environment where data is queried on Windows, response times can be slow without a transaction monitor like Novell's Tuxedo.

c. Systems Management Software

Over the past 20 years, a large amount of sophisticated software has been developed to support capacity management, operations scheduling, data center management and network control. The problem is—these tools and utilities were designed to function in hierarchical networks, dominated by large mainframes. The state of the art for delivering comparable functionality in distributed heterogeneous networks is in its infancy. Respondents expressed concerns about current limitations of available software in a variety of ways:

- While some solutions exist to support these functions at a single, local-area network (LAN)-level, very few exist that will deal with the enterprise-wide environment.
- Partial solutions do exist for UNIX on an enterprise-wide basis, but generally will only function on a specific platform.
- Some solutions for specific systems management tasks are provided by vendors at different levels of the software hierarchy, including operating systems, network management systems and database management systems. However, these partial solutions do not coordinate well.

- Many new products, addressing the systems management issue across multiple heterogeneous platforms, come from start-up companies. There is a general buyer reluctance to commit to these offerings until one or more emerge as leaders.

d. Summary—Technology Limitations

To some degree, buyers appear to be less concerned with specific limitations of today's C/S oriented technology, than with the fact that:

- They see few integrated platform solutions that will deal with heterogeneous hardware environments.
- Integration must come through software, and despite the huge number of specific offerings either available or promised, no single vendor's or consortium's architecture has taken a leadership position.

Synthesizing issues expressed by respondents with specific offerings, leads to generalized needs the software industry must address to alleviate C/S migration bottlenecks. They include:

- Smooth interfaces to support solid integration of today's leading products
- Middleware to support a single applications programming interface at some level in the architecture
- Software and related technology to manage the production applications and network environments in a secure, reliable and efficient manner

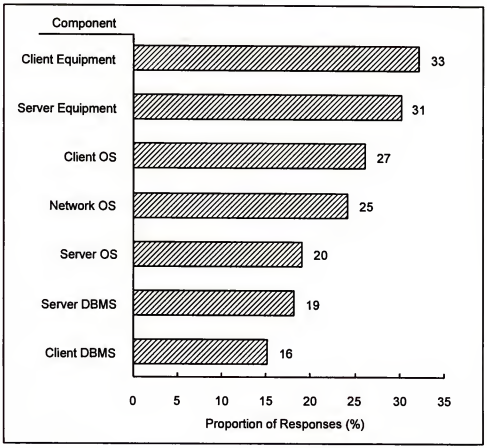
In the meantime, buyers must choose from what they know and what has been promised to patch together a C/S platform.

2. Impact of Legacy Architecture

It has been stated several times throughout the study, that for many components of the C/S platform installed base, legacy architecture was a primary factor in platform selection. Exhibit V-2 compares the proportion of respondents who weighted installed base as the primary reason for selection of each major platform component.

Exhibit V-2

Proportion of Platform Component Selections Based on Installed Base



As can be seen, one-third of respondents rank compatibility with the installed base as the main consideration in selecting client equipment. This makes it especially hard for workstation vendors to penetrate the Intel-based market. However, less than one-fifth of the respondents rate compatibility as the primary reason for selecting a database. This means that database vendors currently have a better likelihood of attracting a new account, than hardware vendors.

Most respondents believe installed hardware architecture will meet present needs, and are reluctant to make the huge expenditures required for a total technology change-over.

These conclusions are reinforced by other survey data indicating price performance was the second most important factor in selecting hardware. Support for applications ranked highest for database management software.

The server platform—equipment and operating system—is the one area where the survey results regarding the impact of legacy architecture may be ambiguous.

- From the equipment standpoint, legacy architecture appears to have a heavy influence on what is selected, largely high-end PCs.
- On the operating system side, those who have not migrated to workstations are sticking with DOS, but few believe they will stay with it over time.

Most likely, the heavy commitment to Intel-based legacy equipment for servers results from buyers forced into a holding pattern on a long-range server decision by operating system futures. Until the performance characteristics and functional capabilities of NT are understood, buyers are simply deferring the decision.

3. Impact of Conversion

The impact of conversion can best be measured by analyzing survey responses pertaining to ease of migration, the availability of applications and compatibility. Exhibit V-3 shows the average ratings for these factors (1 Low — 5 High) for overall platform selection and the database software component.

Exhibit V-3

Platform Selection Factors Indicating The Impact of Conversion on Selection

Influencing Factor	Overall Avg. (1-5)	Database Avg. (1-5)
Compatibility	4.2	3.4
Availability of Applications	4.0	3.6
Ease of Migration	3.5	3.6

In terms of the conversion of the overall platform, the data clearly indicates that buyers look for compatibility with their existing environment and the availability of as many applications as possible. However, this does not necessarily indicate that concerns about conversion are a key driving force.

- The strong desire for compatibility may reflect that most buyers intend to migrate their applications to C/S platforms over a significant period of time. During that period, they must operate in both their traditional and new environments. The more compatible these two environments are, the easier it will be to share data across platforms and make an orderly transition.

- The "just above average" concern for ease of migration is probably because the majority of respondents plan to remain with architectures already in place, making conversion a minor problem.

One might expect the average ratings for factors, related to the conversion of the database platform component, to be higher. The following offers some rationale as to why this is not the case.

- Buyers see a major shift in database strategies as essential to obtain the benefits of C/S computing. While there is concern about conversion issues, they see it as less important in selecting the database platform component than getting the right architecture into place.

- Many companies indicate they will replace existing applications with off-the-shelf software designed for the C/S environment or totally re-engineer their existing applications. In these cases, there will be little to convert, with the exception of the actual data.

- In most cases, vendors of distributed relational database systems will provide tools and assistance to support the actual data conversion from popular hierarchical database systems to their products. In cases where this is feasible, conversion becomes a less important issue.

Overall, it appears that issues related to conversion are of some concern, but not a key driving force in the platform selection process. For the most part, buyers select C/S equipment and operating systems that will integrate easily with what they have in place, and view whatever problems they incur, through re-engineering and converting their applications portfolios, as worth the price.

C
Summary—Buyer Issues

Most issues confronting buyers in C/S platform selection are related to the fact that many of the required technologies are immature or unproven. Despite the myriad of alternatives, no particular combination of components emerges as a proven *de facto* standard. This is particularly true for platform software components where:

- UNIX seems like a logical choice, particularly for servers, but concerns remain regarding standards, integration with popular network management software and its questionable effectiveness running on the large installed base of Intel-based PCs.

- NT remains an unknown, but promises an alternative to UNIX.

- *De facto* standards in the form of DOS/Windows dominate the client side. Other software components must work seamlessly with that architecture.

- Distributed relational database systems are the logical direction to go, but require major re-engineering of existing systems.

Given this environment, the primary issue faced by buyers is whether to commit to newer, but riskier, technologies today and face a potential future change in platform strategy; or bet today's architectures and promised upgrades will provide the capacity and capabilities required for the future. For the most part, buyers take a conservative business approach to resolving this dilemma by:

- Locking in on existing or installed technology on the client side
- Making a tentative commitment to the same strategy on the server side, but monitoring the evolution of UNIX and NT
- Recognizing that database software is probably the most critical component, and going with distributed relational technology as the primary platform for new and re-engineered applications

Buyers seem comfortable with this approach. But it does raise an interesting issue for vendors. While they battle each other on the technology front, the installed base of current technology will grow rapidly, making it more difficult for new vendors to break into the C/S market.

Definitions

A
Information Services

Information Services are computer/telecommunications-related products and services that are oriented toward the development or use of information systems. Information services typically involve one or more of the following:

- Use of vendor-provided computer processing services to develop or run applications or provide services such as disaster recovery or data entry (called Processing Services)
- Packaged software products, including systems software or applications software products (called Software Products)
- People services that support users in developing and operating their own information systems (called Professional Services)
- The combination of products (software and equipment) and services where the vendor assumes total responsibility for the development of a custom integrated solution to an information systems need (called Systems Integration)
- Services that provide operation and management of all or a significant part of a user's information systems functions under a long-term contract (called Systems Operations)
- Services that support the delivery of information in electronic form—typically network-oriented services such as value-added networks, electronic mail and document interchange (called Network Applications)

- Services that support the access and use of public and proprietary information such as on-line databases and news services (called Electronic Information Services)

- Services that support the operation of computer and digital communication equipment (called Equipment Services)

In general, the market for information services does not involve providing equipment to users. The exception is where the equipment is part of an overall service offering such as a turnkey system, a systems operations contract or a systems integration project.

The information services market also excludes pure data transport services (i.e., data or voice communications circuits). However, where information transport is associated with a network-based service (e.g., electronic data interchange services), or cannot be feasibly separated from other bundled services (e.g., some systems operations contracts), the transport costs are included as part of the services market.

B
Market Forecasts/User Expenditures

All information services market forecasts are estimates of User Expenditures for information services. When questions arise about the proper place to count these expenditures, INPUT addresses them from the user's viewpoint: expenditures are categorized according to what users perceive they are buying.

By focusing on user expenditures, INPUT avoids two problems which are related to the distribution channels for various categories of services:

- Double-counting, which can occur by estimating total vendor revenues when there is significant reselling within the industry (e.g., software sales to turnkey vendors for repackaging and resale to end users)

- Missed counting, which can occur when sales to end users go through indirect channels such as mail order retailers

Captive Information Services User Expenditures are expenditures for products and services provided by a vendor that is part of the same parent corporation as the user. These expenditures are not included in INPUT forecasts.

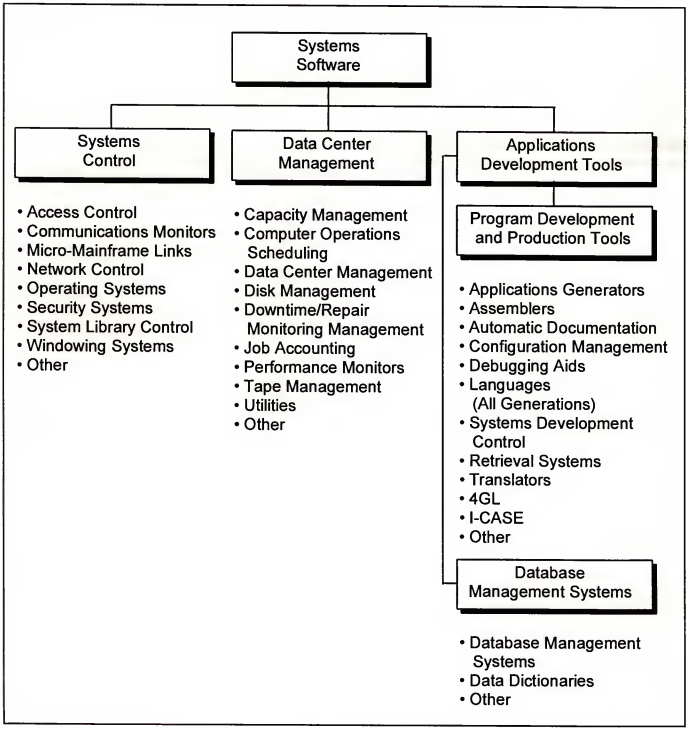
Noncaptive Information Services User Expenditures are expenditures that go to vendors that have a different parent corporation than the user. It is these expenditures which constitute the information services market analyzed by INPUT and that are included in INPUT forecasts.

1. Systems Software Products

Systems software products enable the computer/communications system to perform basic machine-oriented or user interface functions. INPUT divides systems software products into three submodes. See Exhibit A-1.

Exhibit A-1

Systems Software Products–Market Structure



- Systems Control Products - Software programs that manage computer system resources and control the execution of programs. These products include operating systems, emulators, network control, library control, windowing, access control and spoolers.

- Operations Management Tools - Software programs used by operations personnel to manage the computer system and/or network resources and personnel more effectively. Included are performance measurement, job accounting, computer operation scheduling, disk management utilities and capacity management.

- Applications Development Tools - Software programs used to prepare applications for execution by assisting in designing, programming, testing, and related functions. Included are traditional programming languages, 4GLs, data dictionaries, database management systems, report writers, project control systems, CASE systems and other development productivity aids.

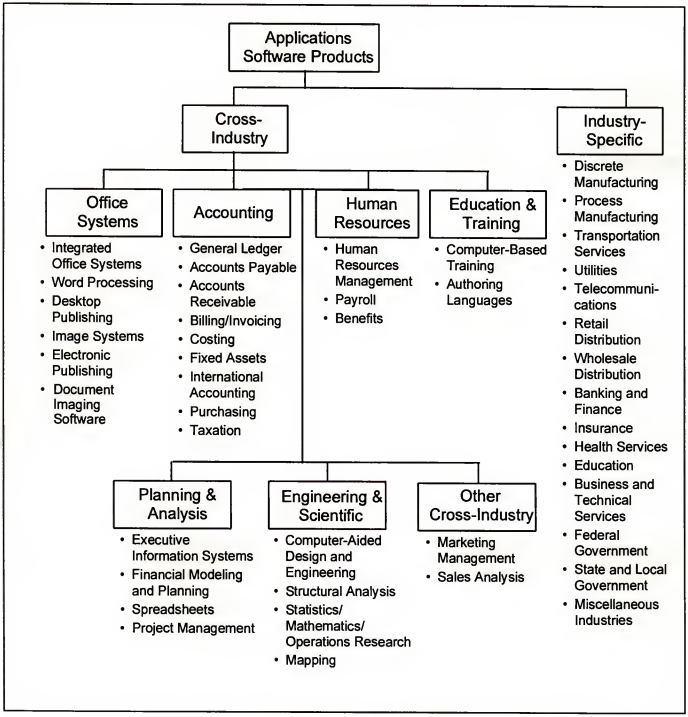
INPUT also forecasts the systems software products delivery mode by platform level: mainframe, minicomputer and workstation/PC.

1. Applications Software Products

Applications software products enable a user or group of users to support an operational or administrative process within an organization. Examples include accounts payable, order entry, project management and office systems. INPUT categorizes applications software products into two groups of market sectors. (See Exhibit A-2.)

Exhibit A-2

Application Products



- Industry Applications Software Products - Software products that perform functions related to fulfilling business or organizational needs unique to a specific industry (vertical) market and sold to that market only. Examples include demand deposit accounting, MRPII, medical record keeping, automobile dealer parts inventory, etc.

- Cross-Industry Applications Software Products - Software products that perform a specific function that is applicable to a wide range of industry sectors. Examples include payroll and human resource systems, accounting systems, word processing and graphics systems, spreadsheets, etc.

INPUT also forecasts the applications software products delivery mode by platform level: mainframe, minicomputer and workstation/PC.

C
Computer Equipment

These definitions have been included to provide the basis for market segmentation.

- Computer Equipment - Includes all computer and telecommunications equipment that can be separately acquired with or without installation by the vendor and not acquired as part of an integrated system. Unless otherwise noted in an INPUT forecast, computer equipment is only included where it is part of the purchase of services or software products (e.g., turnkey systems and systems integration).

- Peripherals - Includes all input, output, communications, and storage devices (other than main memory) that can be channel connected to a processor, and generally cannot be included in other categories such as terminals.

- Input Devices - Includes keyboards, numeric pads, card readers, light pens and track balls, tape readers, position and motion sensors, and analog-to-digital converters.

- Output Devices - Includes printers, CRTs, projection television screens, micrographics processors, digital graphics, and plotters

- Communication Devices - Includes modem, encryption equipment, special interfaces, and error control

- Storage Devices - Includes magnetic tape (reel, cartridge, and cassette), floppy and hard disks, solid state (integrated circuits), and bubble and optical memories

- Computer Systems - Includes all processors from personal computers to supercomputers. Computer systems may require type- or model-unique operating software to be functional, but this category excludes applications software and peripheral devices and processors or CPUs not provided as part of an integrated (turnkey) system.

- Personal computers - Smaller computers using 8-, 16-, or 32-bit computer technology. Generally designed to sit on a desktop and are portable for individual use. Price generally less than $5,000.

- Workstations - High-performance, desktop, single-user computers often employing Reduced Instruction Set Computing (RISC). Workstations provide integrated, high-speed, local network-based services such as database access, file storage and back-up, remote communications, and peripheral support. These products usually cost from $5,000 to $15,000.

- Minicomputer or midsize computers - Minicomputers are generally priced from $15,000 to $350,000. Many of the emerging client/server computers are in this category.

- Mainframe or large computers - Traditional mainframe and supercomputers costing more than $350,000.

- Client/server computing - Client/server is an architecture that assembles applications software and databases, systems software, and computer and networking equipment into a usable form for the purpose of leveraging information technology investments.

Broadly defined, it can include any kind of server, such as file servers and network servers, that are accessed by any kind of client, including a nonintelligent terminal. INPUT has elected to use the narrower and newer definition, by which application and data processing is shared between a client and a server. It is through the act of sharing that the greatest benefit is derived in terms of leveraging information technology investments. It is also the cause of the greatest change for vendors and users.

Survey Questionnaire

The following questionnaire was used to gather information for this study.

User Questionnaire: The C/S Explosion—How Users Choose Platforms

In a previous interview you indicated that you are migrating to C/S platforms. We would appreciate a few minutes of your time to discuss issues surrounding the specific platforms that will be utilized, how and why they were selected, and how those choices might change in the future. Are you the right person? If not, who should we talk to? _____ Phone: _____

When we have completed this survey, we will send you a summary of the results, in addition to the summary from our previous project.

A. Equipment for Servers and Clients

1. What computer/s will be used as the primary platform for *server* functions?

   Vendor/Model: _____

2. Why was this selected? _____

   _____

3. Will servers be specialized or multifunctional?

   ❑ Specialized ❑ Multifunctional

4. If specialized, please describe what functions specialized servers will perform.

   _____

   _____

5. What future changes do you expect regarding the selection of *server* equipment?

   _____

   _____

6. Why will these changes be made?

   _____

   _____

7. What computer will be used as the primary platform for the *client* functions?

   Vendor/Model: _____

8. Why was this selected?

   _____

   _____

B. Operating Systems

9. What operating system will be used on the *server*?

   Operating System: _____

10. Why was this selected?

    _____

    _____

11. What network operating system will be used for connectivity on individual LANs?

    Operating System: _____

12. Why was this selected?

    _____

    _____

13. What operating system will be used on the *client*?

    Operating System: _____

14. Why was this selected?

    _____

    _____

15. What future changes do you expect regarding the selection of operating systems (Server, client and/or LAN)?

_____

_____

_____

16. Why will these changes be made?

_____

_____

_____

For each of the following factors, please indicate on a scale of l (Low) to 5 (High) to what degree the factor influenced platform selection (hardware, operating systems and LAN software).

17a. _____ Price

17b. _____ Compatibility with current operating/network environments

17c. _____ Ease of migration of existing applications

17d. _____ Relationships with existing vendors

17e. _____ Corporate strategies with regard to downsizing

17f. _____ Corporate or divisional technology standards

17g. _____ Availability of applications software compatible with the operating environment

17h. _____ Other: _____

Comments: _____

_____

C. Database Management Systems

18. Which DBMS (or type of DBMS) will be used at the *server* level?

    Name/Type: _____

19. Why was this selected?

    _____

    _____

20. Which DBMS will be used at the client level (if different)?

    Name/Type: _____

21. Why was this selected?

    _____

    _____

22. What future changes do you anticipate in DBMS?

    _____

    _____

23. Why will these changes be made?

    _____

    _____

    For each of the following factors, please indicate on a scale of 1 (Low) to 5 (High) to what degree the factor influenced database management system selection.

24a. _____ Price

24b. _____ Compatibility with current database management systems

24c. _____ Ease of migration to the new database environment

24d. _____ Relationships with existing vendors

24e. _____ Corporate or divisional technology standards

24f. _____ Availability of applications software that runs on the database management system

24g. _____ Other:

Comments: _____

_____

D. Applications Development Environments (ADE)

25. What methodologies and/or packages from which vendors will be used for applications development?

_____

_____

_____

E. Issues Impacting C/S Technology Choices

Please rate on a scale of 1 (Low) to 5 (High) the importance of the following organizations/persons in the choice of C/S technology platforms, and describe their role.

	Organization/Person	(a) 1-5	(b) Role
26.	Central Information Systems		
27.	User/Divisional Information Systems		
28.	User Management		
29.	Other		

Please rate on a scale of 1 (Low) to 5 (High) the importance of each of the following in making your C/S platform choice; describe the role of each in the process.

		(a) 1-5	(b) Role
30.	Internal Staff Analysis		
31.	Independent Outside Consultants		
32.	Vendor Consultants		
33.	Other:		

On a scale of 1 (Low) to 5 (High), please indicate to what degree each of the following influenced your overall decision making process with regard to the selection of a C/S technology strategy.

34a. _____ Limitations on current technology

34b. _____ Necessity to convert existing legacy systems

34c. _____ Lack of standards across one or more components of the architecture

34d. _____ Availability of applications software

34e. _____ Cost of replacement of the current infrastructure

34f. _____ Other: _____

How many of each platform type are currently installed? How many of each do you anticipate will be installed by the end of 1994? By the end of 1997?

	Platform	(a) Now	(b) 1994	(c) 1997	(d) Comments
35.	Servers				
36.	Clients				

37. How many Local Area Networks (LANS) are and will be operational within your organization at year end?

(a) _____ 1993 (b) _____ 1994 (c) _____ 1997

We want to thank you for participating in this survey. A synopsis of the study findings will be sent to you in September.