

INPUT

---

STRATEGIC MARKET PERSPECTIVE

---

# Object-Oriented Platforms for Client/Server Systems

---

Client/Server Software Program



AUGUST 1994

---

# Object-Oriented Platforms for Client/Server Systems

*INPUT*  
*U. B. RAM*

**INPUT<sup>®</sup>**

---

Frankfurt • London • New York • Paris • San Francisco • Tokyo • Washington, D.C.

Clients make informed decisions more quickly and economically by using INPUT's services. Since 1974, information technology (IT) users and vendors throughout the world have relied on INPUT for data, research, objective analysis and insightful opinions to prepare their plans, market assessments and business directions, particularly in computer software and services.

Contact us today to learn how your company can use INPUT's knowledge and experience to grow and profit in the revolutionary IT world of the 1990s.

## SUBSCRIPTION SERVICES

- **Information Services Markets**
  - Worldwide and country data
  - Vertical industry analysis
- **Business Integration Markets**
- **Client/Server Applications and Directions**
- **Client/Server Software**
- **Outsourcing Markets**
- **Information Services Vendor Profiles and Analysis**
- **EDI/Electronic Commerce**
- **U.S. Federal Government IT Markets**
- **IT Customer Services Directions (Europe)**

## SERVICE FEATURES

- Research-based reports on trends, etc. (Over 100 in-depth reports a year)
- Frequent bulletins on events, issues, etc.
- 5-year market forecasts
- Competitive analysis
- Access to experienced consultants
- Immediate answers to questions
- On-site presentations
- Annual conference

## DATABASES

- **Software and Services Market Forecasts**
- **Software and Services Vendors**
- **U.S. Federal Government**
  - Procurement Plans (PAR)
  - Forecasts
  - Awards (FAIT)
- **Commercial Application (LEADS)**

## CUSTOM PROJECTS

For Vendors—analyze:

- **Market strategies and tactics**
- **Product/service opportunities**
- **Customer satisfaction levels**
- **Competitive positioning**
- **Acquisition targets**

For Buyers—evaluate:

- **Specific vendor capabilities**
- **Outsourcing options**
- **Systems plans**
- **Peer position**

## OTHER SERVICES

Acquisition/partnership searches

## INPUT WORLDWIDE

### Frankfurt

Sudetenstraße 9  
D-35428 Langgöns-  
Niederkleen  
Germany  
Tel. +49 (0) 6447-7229  
Fax +49 (0) 6447-7327

### London

17 Hill Street  
London W1X 7FB  
England  
Tel. +44 (0) 71 493-9335  
Fax +44 (0) 71 629-0179

### New York

400 Frank W. Burr Blvd.  
Teaneck, NJ 07666  
U.S.A.  
Tel. 1 (201) 801-0050  
Fax 1 (201) 801-0441

### Paris

24, avenue du Recteur  
Poincaré  
75016 Paris  
France  
Tel. +33 (1) 46 47 65 65  
Fax +33 (1) 46 47 69 50

### San Francisco

1881 Landings Drive  
Mountain View  
CA 94043-0848  
U.S.A.  
Tel. 1 (415) 961-3300  
Fax 1 (415) 961-3966

### Tokyo

Saida Building, 4-6,  
Kanda Sakuma-cho  
Chiyoda-ku, Tokyo 101  
Japan  
Tel. +81 3 3864-0531  
Fax +81 3 3864-4114

### Washington, D.C.

1953 Gallows Road  
Suite 560  
Vienna, VA 22182  
U.S.A.  
Tel. 1 (703) 847-6870  
Fax 1 (703) 847-6872

# Abstract

This report describes the leading vendors of object-oriented environments, visual development tools, and object databases. The report discusses trends, issues and opportunities and assesses vendor strengths and weaknesses. It discusses applications that are using object-oriented technology. Finally, the report provides recommendations for software vendors, systems integrators and users.

This report contains 140 pages, including 34 exhibits.

Published by  
INPUT  
1881 Landings Drive  
Mountain View, CA 94043-0848  
United States of America

## **Client/Server Software Program**

### ***Object-Oriented Platforms for Client/Server Systems***

Copyright © 1994 by INPUT. All rights reserved. Printed in the United States of America. No part of the publication may be reproduced or distributed in any form, or by any means, or stored in a database or retrieval system, without the prior written permission of the publisher.

The information provided in this report shall be used only by the employees of and within the current corporate structure of INPUT's clients, and will not be disclosed to any other organization or person including parent, subsidiary or affiliated organization without prior written consent of INPUT.

INPUT exercises its best efforts in preparation of the information provided in this report and believes the information contained herein to be accurate. However, INPUT shall have no liability for any loss or expense that may result from incompleteness or inaccuracy of the information provided.

# Table of Contents

---

I	Introduction	I-1
	A. Purpose of the Report	I-1
	B. Scope	I-2
	C. Methodology	I-3
	D. Related Reports	I-4

---

II	Executive Overview	II-1
	A. Summary	II-1
	B. Key Trends and Issues	II-1
	C. Markets and Applications	II-2
	D. Vendor Summary	II-4
	E. Recommendations	II-4
	F. Conclusions	II-5

---

III	Background	III-1
	A. Commercial Motivation	III-1
	B. Technical Motivation	III-2
	C. Framework for Analysis	III-2
	D. Objects in the Enterprise	III-3
	E. Object-Oriented Programming	III-6
	1. OO Operating Environments	III-7
	2. Visual Development Tools	III-8
	3. Object Databases	III-8
	F. Does Object-Oriented Programming Make A Difference?	III-8

## IV

<b>Trends</b>	<b>IV-1</b>
<b>A. State of the Art</b>	<b>IV-1</b>
1. Early OO Software	IV-1
2. Growth in the Use of Objects with C/S Networks	IV-1
<b>B. Impact of Objects on C/S Computing</b>	<b>IV-2</b>
<b>C. Summary of Trends</b>	<b>IV-2</b>
1. Design Trends	IV-3
2. Logic Trends	IV-4
<b>D. Object-Oriented Environments</b>	<b>IV-4</b>
1. Object-based Architecture	IV-4
2. Multiple Personality Operating Environments	IV-5
3. How Long Will It Take To Adapt to OO Environments?	IV-6
4. Will Any Competitor Threaten Microsoft's Installed Base?	IV-6
5. Other OO Environment Trends	IV-7
<b>E. Visual Development Tools</b>	<b>IV-7</b>
1. Enterprise Support	IV-7
2. Code-Free Programming	IV-7
3. Other Trends	IV-8
<b>F. Object Databases</b>	<b>IV-9</b>
<b>G. How Trends Affect Users and Vendors</b>	<b>IV-10</b>
1. Effects on Users	IV-10
2. Effects on Corporate IS Departments	IV-11
3. Effects on Software Vendors	IV-12
4. Opportunities for New Services	IV-12
<b>H. What Is Likely To Happen between 1994 and 1999?</b>	<b>IV-13</b>

## V

<b>Issues</b>	<b>V-1</b>
<b>A. Key Issues for Object-Oriented Environments</b>	<b>V-1</b>
<b>B. Key Issues for Object-Oriented Visual Development Tools</b>	<b>V-2</b>
<b>C. Key Issues for Object-Oriented Databases</b>	<b>V-2</b>
<b>D. When Are Object-Oriented Platforms Appropriate?</b>	<b>V-3</b>
<b>E. Migration Strategy</b>	<b>V-4</b>
<b>F. Strengths and Weaknesses of an Object-Oriented Approach</b>	<b>V-5</b>



## V

- |               |     |
|---------------|-----|
| 1. Strengths  | V-5 |
| 2. Weaknesses | V-5 |
| G. Standards  | V-6 |

## VI

- |                                       |       |
|---------------------------------------|-------|
| Market Analysis                       | VI-1  |
| A. Market Description                 | VI-1  |
| 1. Barriers to Entry                  | VI-1  |
| 2. Object-oriented Environment Market | VI-1  |
| 3. Visual Development Tool Market     | VI-2  |
| 4. Object Database Market             | VI-3  |
| B. Vendor Revenue Share               | VI-3  |
| 1. Operating Environment Vendors      | VI-3  |
| C. User Spending                      | VI-8  |
| 1. Operating Environments             | VI-8  |
| 2. OO Platforms                       | VI-10 |

## VII

- |                             |       |
|-----------------------------|-------|
| Customer Analysis           | VII-1 |
| A. Key Customers            | VII-1 |
| 1. Customer Characteristics | VII-1 |
| 2. Critical Success Factors | VII-1 |
| B. Typical Applications     | VII-2 |

## VIII

- |                                    |         |
|------------------------------------|---------|
| Vendors                            | VIII-1  |
| A. Product and Vendor Summary      | VIII-1  |
| B. Vendor Strengths and Weaknesses | VIII-3  |
| 1. ADB                             | VIII-3  |
| 2. Apple                           | VIII-4  |
| 3. Borland                         | VIII-7  |
| 4. Digitalk                        | VIII-8  |
| 5. Easel                           | VIII-9  |
| 6. Forté                           | VIII-11 |
| 7. Fujitsu                         | VIII-12 |

## VIII

8. Gupta	VIII-13
9. Hewlett-Packard (HP)	VIII-15
10. IBM	VIII-16
11. Illustra	VIII-17
12. Intellicorp	VIII-19
13. KnowledgeWare	VIII-19
14. Magic Software Enterprises	VIII-21
15. Microsoft	VIII-22
16. Neuron Data	VIII-25
17. NeXT	VIII-26
18. Novell	VIII-28
19. Object Design	VIII-29
20. Objectivity	VIII-30
21. ONTOS	VIII-31
22. Open Data	VIII-32
23. Oracle	VIII-33
24. ParcPlace	VIII-34
25. Persistence Software	VIII-37
26. POET Software	VIII-38
27. Powersoft	VIII-39
28. Raima	VIII-41
29. Sapiens	VIII-41
30. Servio	VIII-42
31. SunSoft	VIII-43
32. Sybase	VIII-44
33. Taligent	VIII-45
34. Trinzic	VIII-47
35. UniSQL	VIII-49
C. Typical Support Strategies	VIII-50
D. Distribution Channel Analysis	VIII-52
E. Standards Organizations	VIII-57
F. Alliances	VIII-59

## IX

Recommendations and Conclusions	IX-1
A. Recommendations	IX-1
1. Recommendations for Users and Developers	IX-1
2. Recommendations for Software Vendors	IX-2

3.	Recommendations for Systems Integrators and VARs	IX-2
4.	Opportunities for New Services	IX-2
<b>B.</b>	<b>Conclusions</b>	<b>IX-3</b>

---

<b>A</b>	<b>Definitions</b>	<b>A-1</b>
----------	--------------------	------------

---

<b>B</b>	<b>Vendor Names and Addresses</b>	<b>B-1</b>
	<b>A. Vendors and Organizations</b>	<b>B-1</b>

---

<b>C</b>	<b>Explanation of Financial Data</b>	<b>C-1</b>
	<b>A. U.S. Forecasts</b>	<b>C-1</b>
	<b>B. Worldwide Forecasts</b>	<b>C-2</b>

# Exhibits

I	Introduction	I-1
II	Executive Overview	II-1
	-1 Key Trends and Issues	II-2
	-2 Market Forecast for OO Platforms, U.S. 1994-1999	II-3
III	Background	III-1
	-1 Systems Software Categories and Representative Vendors	III-2
	-2 Enterprise Systems	III-4
	-3 Approaches to OO Programming	III-7
	-4 Alternative OO Environments	III-9
IV	Trends	IV-1
	-1 Impact of Objects on C/S Systems	IV-2
	-2 Summary of Major Trends	IV-3
	-3 Client Operating Environment Trends	IV-5
	-4 Scenarios for Operating Environments	IV-13
	-5 Scenarios for Visual Development Tools	IV-15
	-6 Scenarios for ODBMSs	IV-16

V	Issues	V-1
	-1 Strategies for Migrating Legacy Applications Using Objects	V-4
VI	Market Analysis	VI-1
	-1 Systems Software Vendor Revenues, 1993-1994	VI-4
	-2 Visual Development Tool Vendors' U.S. Revenue Share, 1994	VI-5
	-3 Visual Development Tool Vendors' U.S. Revenue Share, 1999	VI-6
	-4 Object Database Vendors' U.S. Revenue Share, 1994	VI-7
	-5 Object Database Vendors' U.S. Revenue Share, 1999	VI-7
	-6 Worldwide User Spending on Client OO Environments	VI-9
	-7 User Spending on OO Platforms—U.S. 1994-1999	VI-10
	-8 User Spending on OO Platforms—Worldwide 1994-1999	VI-11
VII	Customer Analysis	VII-1
	-1 Applications Built Using OO Platforms	VII-2
VIII	Vendors	VIII-1
	-1 OO Environments—Vendors and Products	VIII-1
	-2 Visual Development Tools—Vendors and Products	VIII-2
	-3 Development Tools—Vendors and Products	VIII-3
	-4 Support Strategies of Select Vendors	VIII-51
	-5 Channel Strategies of Leading OO Environment Vendors	VIII-53
	-6 Channel Strategies of Visual Development Tool Vendors	VIII-54
	-7 Channel Strategies of Object Database Vendors	VIII-56
	-8 Alliances	VIII-59

---

IX	Recommendations and Conclusions	IX-1
----	---------------------------------	------

---

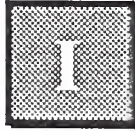
A	Definitions	A-1
---	-------------	-----

---

B	Vendor Names and Addresses	B-1
	-1 Names and Addresses of Vendors	B-1
	-2 Names and Addresses of Organizations	B-9

---

C	Explanation of Financial Data	C-1
	-1 Market Forecast for OO Platforms—U.S. 1994-1999	C-1
	-2 Market Forecast for OO Platforms—Worldwide 1994-1999	C-2



# Introduction

The operating system, database and application development tool markets are in a state of turmoil as object-oriented (OO) technology is embraced by winning corporations. This report analyzes trends, issues, markets and vendors.

## A

---

### Purpose of the Report

Objects are components of software systems. Business processes can be modeled using objects. The flexibility, efficiency and ease with which objects can be re-engineered is enabling businesses to offer new products and services with unprecedented speed.

The OO platforms discussed here are:

- OO operating environments
- OO development tools
- OO databases

This report discusses the impact of these platforms on client/server (C/S) computing, reviews the major vendors and provides market forecasts. It also lists some applications of object technology.

Charts and tables in the report summarize market forecasts and may be used for business presentations and market planning. For vendors of OO software, the report indicates trends. For systems integrators and hardware manufacturers, it describes potential software partners. For users, it reviews leading vendors and describes the use of OO technology. For investors, it analyzes companies' strengths and weaknesses.

---

**B****Scope**

The report answers the questions:

- Who will be the winners in OO programming?
- What opportunities are there for developers?
- What are the strengths and weaknesses of leading OO software vendors?
- What applications and market segments are most likely to use OO technology?
- Why are users adopting OO software?
- What pitfalls are to be avoided in implementing an OO operating system?
- How big is the market for OO tools?

The term *object-oriented* varies in meaning. Some apply the term to user interfaces that support icons, windows and images as well as text objects, like those found on Apple Macintosh and Microsoft Windows computers. Others use the term to describe business objects like people, places and processes. Programmers use the term to describe specific programming language attributes.

In this report, *object-oriented* will be used to describe software written in object-oriented languages like Smalltalk and Objective C. *Object-based* describes development tools that use components like windows, scroll bars, buttons and graphics, but are not based on an object-oriented language. Application development tools that are either object-oriented or object-based and may be used to develop user interfaces will be described as *visual development tools*.



An *OO platform* is a program development environment that runs, and is used to develop, OO applications. This report describes three different families of OO platforms:

- OO operating environments for client PCs and workstations
- Visual development tools
- OO databases (OODBMSs) and object-relational databases (ORDBMSs)

This report focuses on OO operating environments for client workstations and PCs. It does not cover:

- Server operating systems, like that for IBM's AS/400 series of computers, which has OO components
- Distributed object environments like those based on the Object Management Group's (OMG's) Common Object Request Broker Architecture (CORBA), for example IBM's DSOM architecture
- Operating systems for personal digital assistants (PDAs)
- Component Integration Laboratory's OpenDoc
- Microsoft's Object Linking and Embedding (OLE)

OpenDoc and OLE will be covered in a later report in this series on object exchange. This report focuses on software companies.

## C

---

### Methodology

The report is based on interviews with the vendors mentioned in this report and a select group of about twenty users. It is also based on secondary research from trade publications, on-line technical forums and vendor literature.

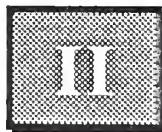
**D****Related Reports**

---

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 Vendor Analysis Program and in its Client/Server Vendor Profiles.



# Executive Overview

## A

---

### Summary

Retailers, telephone companies, financial institutions and hospitals are accelerating business processes. Objects are the building blocks that automate business processes. They will connect a highly mobile work force with corporate systems.

A battle is developing for the next generation of object-oriented PC and workstation platforms. Will Smalltalk, NeXT or CAIRO win? Software components built on these platforms will revolutionize the economics of application development. Industry leaders are making major commitments to flexible, cross-platform systems that realize the promise of object technology.

This report identifies the leading vendors of object-oriented applications software development tools and forecasts the market. It explains trends and issues and makes recommendations for vendors, users and integrators of OO software.

## B

---

### Key Trends and Issues

A major trend is the use of business objects that enable an enterprise to model its environment. These high-level objects can then be translated into applications software. Leading tools are focusing on automatic code generation to support business objects.

Objects are essential for programming client/server systems of complexity. They are reducing the time to create systems, the cost of updating them and the cost of adding additional components. Legacy systems that use 3270 and ASCII terminals for data entry

may support system extensions based on objects. Exhibit II-1 shows key trends and issues.

Exhibit II-1

### Key Trends and Issues

Trends	Issues
<p>Smalltalk-based development tools are gaining commercial acceptance.</p> <p>Systems are being built in days or weeks, instead of months, using object-oriented tools.</p> <p>Systems integrators and corporate developers are increasingly building libraries of reusable objects.</p> <p>Microsoft is likely to be the leading object-oriented platform vendor.</p>	<p>Object-oriented COBOL is starting to be marketed and could slow Smalltalk growth as a language for corporate applications software developers.</p> <p>Professional services firms are changing their billing structures to base them on fixed-price bids, so as not to lose compensation as software development tools become more efficient.</p> <p>Managing re-use is critical to success.</p> <p>Large objects are candidates for re-use; smaller objects can be recoded faster than the time it takes to find them.</p> <p>IBM, HP and Sun are companies with sufficient financial resources to present a serious challenge.</p>
<p>Object developers need to focus on standards, as minor variations in object environments will cause problems for application developers.</p>	<p>Like UNIX, a system built from many components, variants on object-oriented platforms will become common. This will provide an opportunity for systems integrators that can connect disparate systems.</p>

Source: INPUT

## C

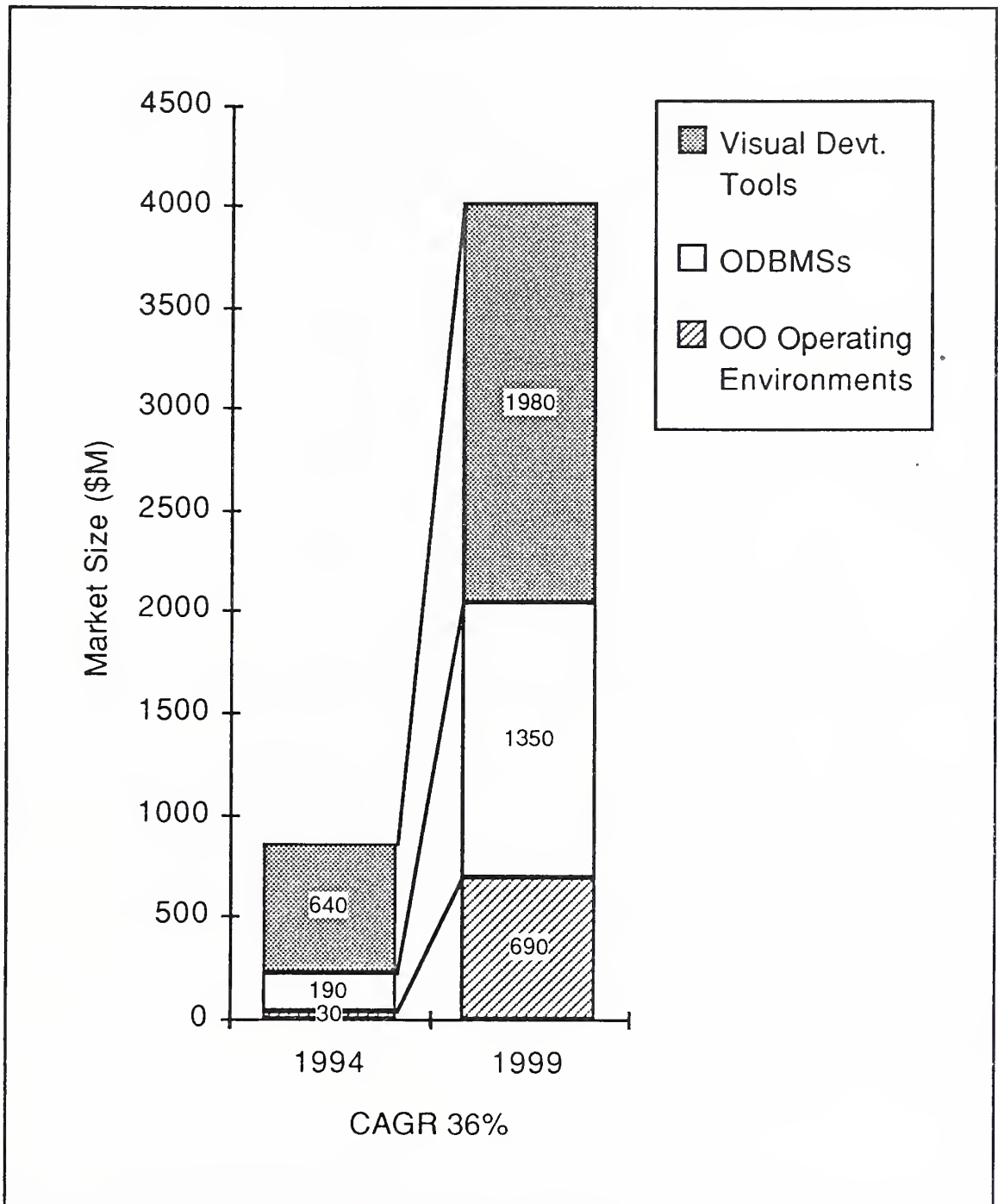
### Markets and Applications

U.S. user spending on OO platforms is projected to grow at 36%, from \$860 million in 1994 to \$4 billion in 1999, as illustrated in Exhibit II-2. Increasingly, object-oriented and object-relational databases will represent a larger percentage of the tools.

Worldwide user spending on OO platforms is projected to grow at 47%, from \$1 billion in 1994 to \$7 billion in 1999.

Exhibit II-2

## Market Forecast For OO Platforms, U.S. 1994-1999



Source: INPUT

Objects are found across many industries. Some of the early adopters of object technology are found in financial services, health care, document management, government and telecommunications. Object-oriented databases are increasingly

**D**

---

**Vendor Summary**

This report discusses the strategies of over 30 vendors of object-oriented operating environments, development tools and databases. It provides an analysis of their strengths and weaknesses, discusses distribution strategies and reviews customer support offerings.

NeXT and Taligent are the technology leaders in object-oriented operating environments, in addition to Microsoft. Their technology will replace traditional operating systems or be integrated with them to provide new classes of user interfaces and applications. Users have to decide whether they want an efficient environment like NeXTSTEP or a standard environment like Windows.

The main growth will come from object-based development tools like Powersoft's PowerBuilder that are simple, well-designed and widely marketed. Smalltalk-based tools like ParcPlace's VisualWorks, Easel's Object Studio and Digitalk's PARTS are enabling developers to rapidly integrate their existing systems and add visual interfaces. NeXT, with an integrated object-oriented operating environment, is seeing success in specialized markets like financial services and cellular telephony. Object Design, Versant and Objectivity, whose revenues doubled in 1993, will continue to grow as leading vendors of object-oriented databases.

**E**

---

**Recommendations**

Developers of object-oriented platforms need to:

- Build alliances to handle distribution, applications development and integration with existing systems
- Organize their development and marketing to support business processes that can be accelerated using their technology; for example, customer service operations may be made more efficient using object-oriented software
- Invest in object frameworks

- Develop cross-platform capabilities

Software developers, systems integrators and users building applications on object-oriented platforms need to:

- Specialize in a few key platforms
- Create an infrastructure to manage object re-use at appropriate levels (small objects may not be worth re-using and large objects may not have widespread applicability)
- Support programming teams with appropriate tools
- Invest in applications expertise
- Select areas where the use of objects improves operations, such as multimedia decision support, sales and marketing systems, and support for mobile professionals

## F

---

### Conclusions

OO technology is already widely applied, and companies that are using it, after some rough starts, have a competitive advantage. Using OO technology, Swiss Bank creates new financial services, MCI changes telephone service features and McCaw will use electronics retailers to initiate cellular phone service.

Object-oriented technology presents new opportunities for services in:

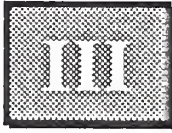
- Multimedia information dissemination
- Consumer messaging
- Network and systems management

The main conclusions are:

- OO technology requires fundamentally new management techniques for it to succeed.
- Leading-edge vendors are investing heavily in objects.
- The systems integration business is changing radically because of OO technology. Systems integrators and professional services firms need to build their own object libraries for specific markets and applications that they can rapidly customize.
- Object-oriented environments are changing the way in which vendors price their services. Vendors that can develop applications rapidly are pricing professional services by value to the customer. They may share in the savings of an object-oriented system, bill depending on system use, or charge a fixed price higher than that warranted by time-and-materials billing.
- The most successful tools will be sold in modules that can be scaled to support individual programmers and programming teams.

In summary, object-oriented technology has evolved from being used by a few highly skilled programmers to being a mainstream strategy for systems integrators and IS organizations.





# Background

This chapter looks at the motivation for developing systems using OO technology from both a business and technical perspective. It provides a framework for analysis and shows how objects may be used in an enterprise.

## A

---

### Commercial Motivation

OO distributed processing represents the present and future of client/server development. Organizations are investing millions of dollars to retrain programmers in OO technologies. Systems integrators and corporate developers are investing in objects and building infrastructures that enable them to rapidly change and develop systems. If they fail to do this, competitors will be able to run their businesses faster using superior system infrastructures.

The main reasons for investing in OO platforms are to:

- Develop systems quickly for competitive advantage
- Rapidly change products and services
- Enable user organizations to create systems that more closely meet their needs
- Integrate information such as charts, tables, videos and images into documents and presentations
- Develop software components that can be interchanged and moved onto different computers
- Simplify complex system architectures
- Provide scalable solutions

**B****Technical Motivation**

Information technology managers and software developers are using objects because they promise:

- Code re-use
- Programmer productivity using higher levels of code abstraction
- Modular engineering, leading to more reliable code
- Support for new classes of problems, beyond forms-based databases
- Improved maintenance and support
- More powerful applications

In reality, because a particular language or operating environment is OO does not guarantee that the benefits of OO programming will be realized. Much depends on a programmer's style, experience with tools to manage objects and knowledge of system architecture.

**C****Framework For Analysis**

The software vendors described in this report sell systems software products that fall into three main categories. Exhibit III-1 shows representative vendors in each category.

Exhibit III-1

**Systems Software Categories and Representative Vendors**

<b>Systems Software Category</b>	<b>Major Vendors and Products</b>
OO operating environments	Apple, IBM, Microsoft, NeXT, Novell, Taligent
Visual development tools	Digitalk, Easel, Forté, Gupta, ParcPlace, Powersoft
ODBMSs	Illustra, Object Design, Objectivity, UniSQL, Versant

Source: INPUT

In addition to discussing the primary technology vendors, a brief review will be made of vendors that compete indirectly. For example, Oracle and Sybase compete indirectly with OO database vendors. Many users combine traditional databases with OO tools to compete with ODBMSs.

## D

---

### Objects in the Enterprise

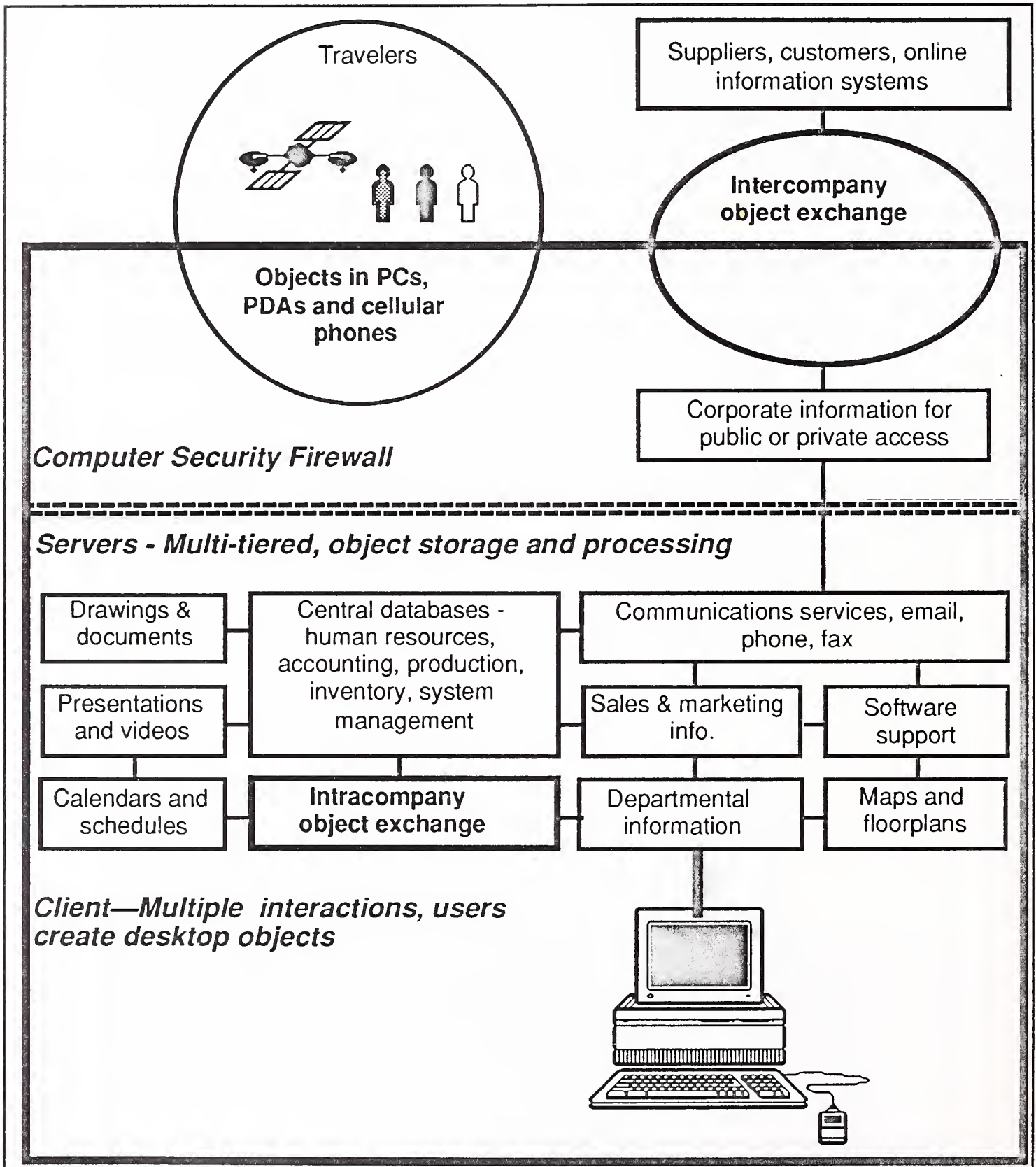
The enterprise of the next five years will rely more on networking, document workflow and electronic messaging than on human resources, accounting and inventory systems. Failure of a corporate network will have a more severe impact on a business than failure of its accounting system.

Objects will be exchanged between companies and between individuals, whether traveling or in the office. Exhibit III-2 shows how enterprise systems may be configured and illustrates:

- *Travelers*—using mobile devices such as PDAs that run OO operating systems, such as Geoworks or the Newton operating system from Apple. Travelers will use OO languages to exchange data with each other and with office systems.
- *The intercompany object exchange*—ensuring that objects can be shared by different organizations. It supports databases and a messaging infrastructure to store and forward objects between organizations. It may reside on a corporate computer or in a public service. Software like IBM's DSOM, based on CORBA standards, partially addresses the problem of connecting different systems. Alternatively, systems like Lotus Notes or Microsoft Mail may be used to store and forward objects. Object exchange is in an early stage of development and will be the subject of a subsequent report in this series.

Exhibit III-2

**Enterprise Systems**



Source: INPUT

- *The computer security firewall*—protecting internal corporate information. It allows external servers to provide technical support information, sales literature, videos, presentations and demonstration software. All may be handled as objects. External servers typically support file download, ASCII text or Lotus Notes because of the lack of object interchange standards. Over the next five years, object technology will enable many data formats to be exchanged.
- *Servers*—supporting a wide range of objects, such as spatial data for maps, images, videos and document components. OO technology can be applied to network management software to simplify the control of such diverse systems. Servers will continually gather information from external organizations, mobile professionals and internal data sources and present them to client devices.
- *A client workstation or PC*—connecting to multiple servers. In reality, there will be multiple clients connected to multiple servers. Microsoft's Object Linking and Embedding (OLE) technology is mainly used to integrate desktop application components at the user workstation. It can link data from servers into spreadsheets and word processing files. It can be used to create decision support systems by integrating numeric data with text documents, such as mail messages. Increasingly, OLE will be used to connect server applications as well as those running on clients. To process objects from many sources requires workstation-class PCs supporting multiple logical interfaces simultaneously with corporate data.

Organizations usually think of data being stored on servers. In reality, it is stored on both client and server platforms. The challenge of the next five years is to integrate data wherever it is found, for individuals who need it, when they demand it.

**E**

---

**Object-Oriented Programming**

This section answers the questions asked by an organization wanting to program in objects about re-engineering a new business process:

- Where should it start?
- Should it try a new operating system like NeXTSTEP and discard Windows?
- Should it use visual development tools on existing computers?
- Should it store information in ODBMSs?
- Should it store information in traditional databases and use visual development tools to manipulate objects?

Three approaches to using OO platforms are summarized in Exhibit III-3.

Exhibit III-3

### Approaches to OO Programming

Systems Software Category	Description	Approach Taken by Programmers
OO operating environments	Operating systems that run mainly on client workstations and PCs.	Replace a traditional operating system such as DOS or Windows with another environment. This may run across multiple existing OSs (like Taligent's TaIAE) or replace them completely (like NeXTSTEP).
Visual development tools	Applications software development tools that are used to create user interfaces. They may connect modules that connect users to databases.	Use visual development tools on top of existing databases and operating systems. The underlying operating system remains unchanged.
ODBMSs	Object databases are databases that store objects. They may be OODBMSs, ORDBMSs or Adapters that connect OO software to RDBMSs.	Instead of storing objects in traditional databases or files, store them either in OO or object-relational databases. Alternatively, use an OO database interface to link applications to a traditional relational database.

Source: INPUT

## 1. OO Operating Environments

*OO operating environments* provide functions commonly found in operating systems like file management, network interfaces and support for peripherals. They are used to run applications. They may optionally include application development tools to create applications for the operating environment. They include NeXTSTEP, a complete operating system, and OpenStep, an environment derived from NeXTSTEP that runs on UNIX. The term "operating environment" is preferred to "operating system," because the trend is toward more modular operating systems. The traditional notion of an operating system will vanish.

## 2. Visual Development Tools

*Visual development tools* are application development tools that have a component that programs the screen display and uses objects. In this report, INPUT includes object-based tools like Gupta's SQL Windows and Powersoft's PowerBuilder, besides true OO tools like ParcPlace's VisualWorks and Easel's ObjectStudio in this category. For simple applications, purchasers may not differentiate between OO and object-based packages. However, for complex or nonrelational applications, the underlying architecture is more important. For example, if the tool requires extensions to be built in a lower-level language, then an OO tool based on Smalltalk may be easier to program than an object-based tool based on C++ or Microsoft's Windows Software Development Kit (SDK).

## 3. Object Databases

*OODBMSs* and *ORDBMSs* will be together called *object databases* (ODBMSs). ODBMSs store objects and provide interfaces to both users and applications. There are three classes of ODBMSs:

- OODBMSs map the structures used in OO programming languages into databases.
- OO adapters link OO systems and standard relational databases.
- ORDBMSs store nontraditional objects, such as image and spatial data, but also support queries similar to relational databases.

---

## F

---

### Does Object-Oriented Programming Make A Difference?

A few years ago, the debate among system developers was between languages. How does C++ compare with Smalltalk or Objective C? The debate is moving to higher level issues.



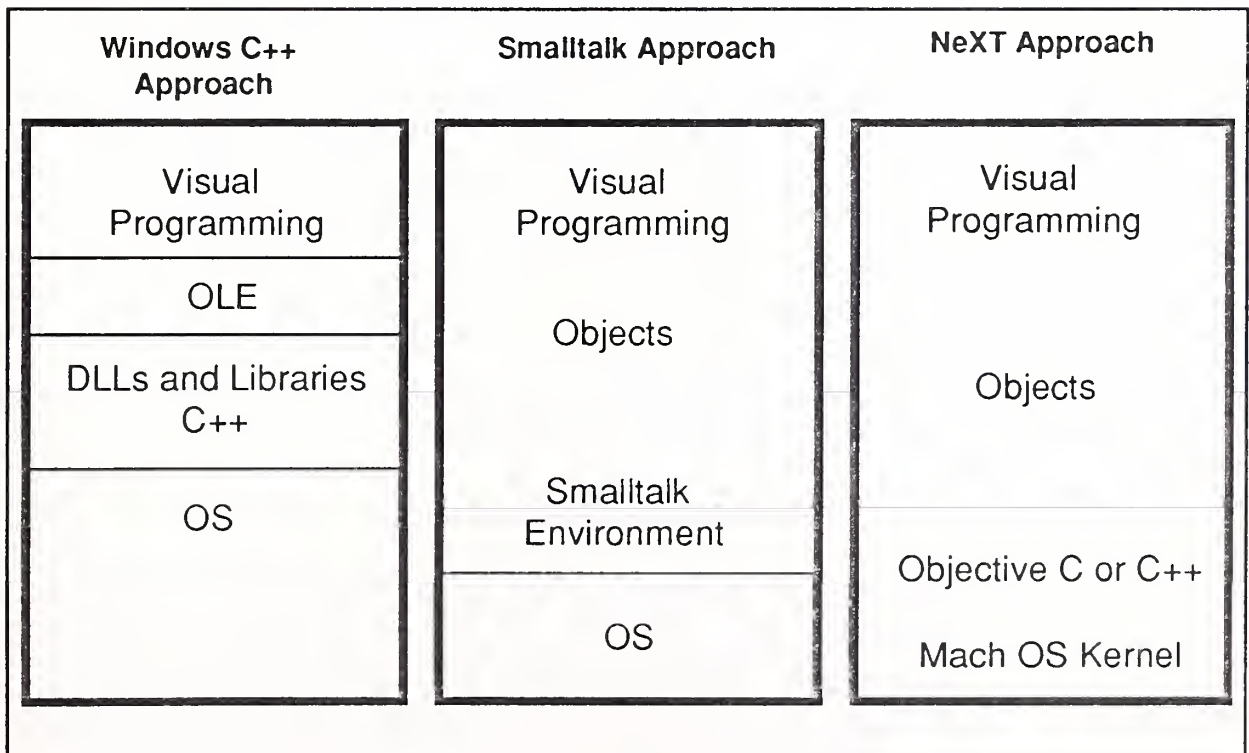
Developers evaluating applications and development tools ask:

- Will the application run across multiple platforms?
- Can the application be modified after it has been deployed?  
Can it be changed if the company's business changes?
- Is it possible to access lower level system functions from higher level languages to improve performance?
- Does the programming language easily represent business logic?
- Can the development tool handle the application complexity?

Affirmative answers to the above questions often result in choice of an OO tool based on Smalltalk or NeXTSTEP. Programmers familiar with COBOL, Visual Basic or 4GL find Smalltalk easier to learn than C++. To program at low levels requires a tool that can scale from low-level to high-level programming, as shown in Exhibit III-4.

Exhibit III-4

### Alternative OO Environments



Source: INPUT

The top layer of each block shows the software found in a typical visual tool. At the bottom is the operating system (OS) that is typically shipped with the machine. In the third block the Mach OS kernel, at the heart of NeXTSTEP, ships with the operating environment.

The left-hand block illustrates the situation faced by a typical Windows programmer using a visual tool like PowerBuilder. The programmer who needs to add lower level functionality typically:

- Writes code in C++
- Compiles it as a DLL (Dynamic Linked Library)
- Optionally uses OLE to embed it as an object in other applications
- Adds it to the application using the visual tool

The advantages of this approach are:

- Visual tools are widely available.
- Windows platforms are pervasive.
- The code may be linked into other applications.

The disadvantages are that:

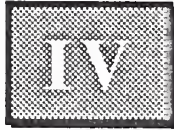
- The language C++ is hard to learn.
- If the code uses any Windows-specific code it will not be portable.
- The programmer has many low-level details like memory management to consider.
- Many separate tools must be purchased.

The second block shows the approach taken by the typical Smalltalk programmer. Smalltalk provides its own operating environment and there are fewer level details for the programmer to consider. Smalltalk generally uses fewer lines of code than C++ and is faster to debug.

The third approach is that taken by NeXT and is the trend for modern operating environments. The lower level code is accessible via higher level libraries. The development system handles levels of code from database interfaces to low-level interrupts. The scalable programming environment, from high-level visual constructs to lower level software libraries, is where object-oriented design improves programmer productivity. NeXT has the most integrated approach of the three, but is not deployed on many platforms.

In summary, object-oriented techniques make a difference to the ease with which programs can be developed, the ability to share components, the consistency of the design and the level at which programs can be modified.

(Blank)



# Trends

This chapter describes the state of the art, discusses the impact of objects on client/server computing, and defines trends.

## A

---

### State of the Art

#### 1. Early OO Software

Simula is generally credited with being one of the first OO languages. It is used for simulation and was created about twenty-five years ago. Early windowing systems at Xerox PARC (Palo Alto Research Center) were written in Smalltalk on proprietary machines. Packaged software vendors have used OO programming since C++ was launched in the early 1980s. Windowing systems have been the main reason for using OO technology in mass-market applications to date.

#### 2. Growth in the Use of Objects with C/S Networks

Client/server applications demand that corporate programmers become familiar with multiple networks, windowed programming environments, and cross-platform development. Networking is complex, and developers who use Microsoft's Windows SDK typically need a year's training. As systems become more distributed, OO technology helps simplify the network programming.

**B****Impact of Objects on C/S Computing**

Exhibit IV-1 shows the impact of objects on different elements of C/S systems that can be expected over the next five years.

Exhibit IV-1

**Impact of Objects on C/S Systems**

<b>System Element</b>	<b>Implications For C/S Computing</b>
User Interface	More integrated look/fewer overlapping windows/can be designed by embedding objects from multiple servers in a single window/more user customizable features
Content	More applications with video, multimedia, telephony, messaging, and animation components
Client/Server Interface	Standard interface objects will simplify certain programming APIs. SQL variations will embed objects and functions (methods) that manipulate objects.
Client Workstation	Will require environment to handle objects, e.g., multimedia objects will require considerable memory (at least 16MB per user), high bandwidth (100Mbps to the desktop) and multiple large screens (19" displays)
Server	Will support object exchange mechanisms (e.g., object request broker) and object storage
System Complexity and Size	Larger systems will become easier to design because objects will integrate lower level components. Also, object standards will make it easier to connect to remote databases.

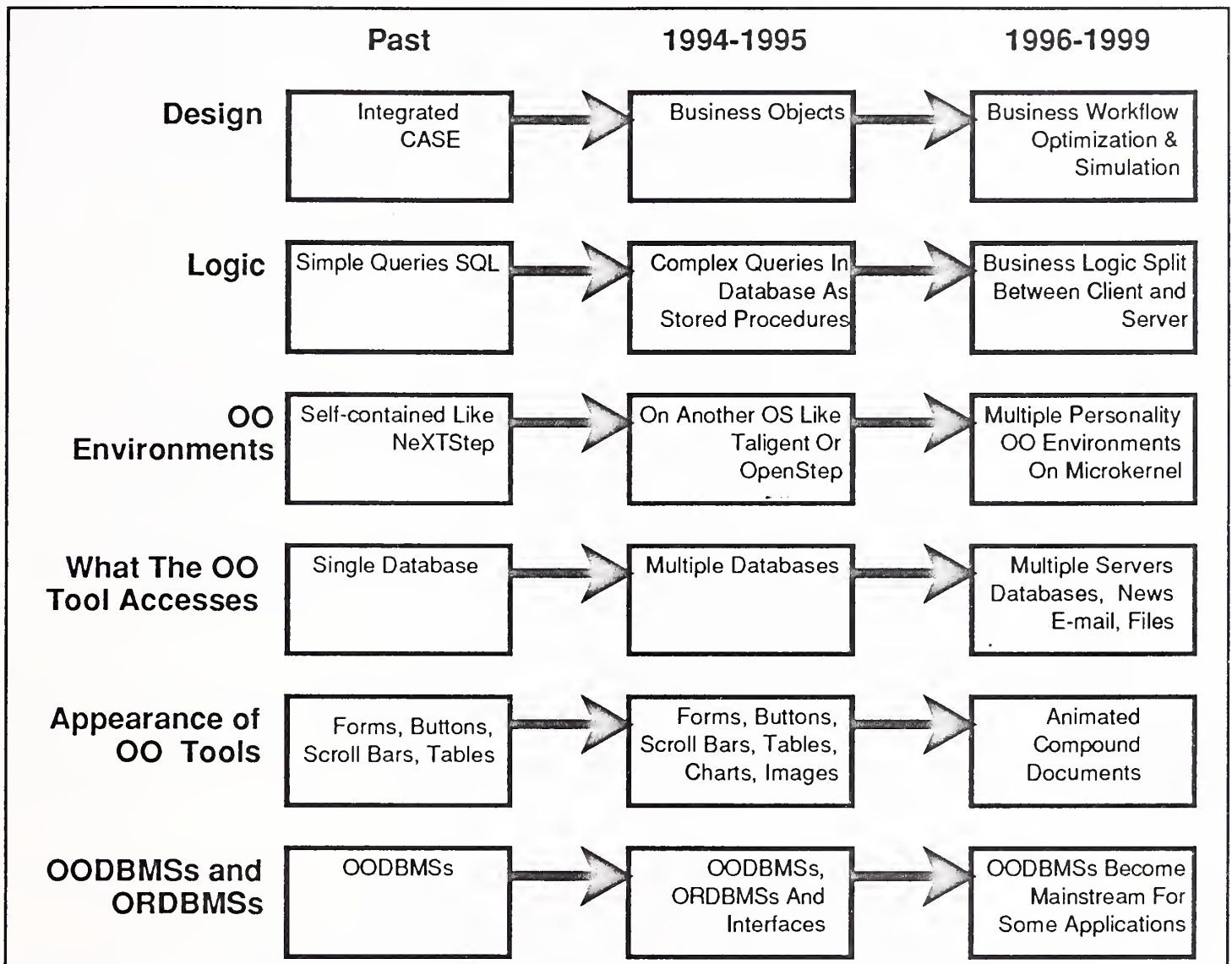
Source: INPUT

**C****Summary of Trends**

Exhibit IV-2 shows the major trends in six areas: design, logic, GUI access, appearance of OO tools, OO environments and OODBMSs. The trends are shown across the page and the topics are shown vertically.

Exhibit IV-2

**Summary of Major Trends**



Source: INPUT

**1. Design Trends**

Some programmers and system architects build a client/server application starting with the design. The design shows how system components interact. When relational databases were first designed, this was done using entity-relationship diagrams. Gradually, methodologies emerged, then CASE tools. CASE tools create diagrams of the workflow and are being integrated with business objects that are directly coded into the application.

Other programmers prefer to write code and build systems from the bottom up. They need to understand how their components

can fit together and may describe their components as business objects. The merging of CASE, software libraries and OO techniques is increasingly leading programmers to use business objects to describe their systems and to build relationships between system components. As development tools that support business objects mature, they may use workflow and database performance statistics to identify bottlenecks using simulation or mathematical optimization.

## 2. Logic Trends

Development tools like SQL Windows and PowerBuilder use SQL as the language for querying databases. Databases store commands to manipulate the database as stored procedures. A problem is that stored procedures are different for each database and they are not easily debugged or tracked. In the future, database access tools will become more powerful, splitting processing of business logic between clients and servers. Agents, generated by client programs, will search for information in multiple databases.

# D

---

## Object-Oriented Environments

### 1. Object-based Architecture

Exhibit IV-3 shows the main trend in OO environments. The three-layered model of an application, a windowing system and an operating system, is changing to one in which suites of applications are constructed from packages that are made from applets. These are constructed from objects and run on an operating system microkernel, the heart of the operating system. For example, in a traditional PC architecture, Microsoft Excel ran on Windows with DOS underneath.

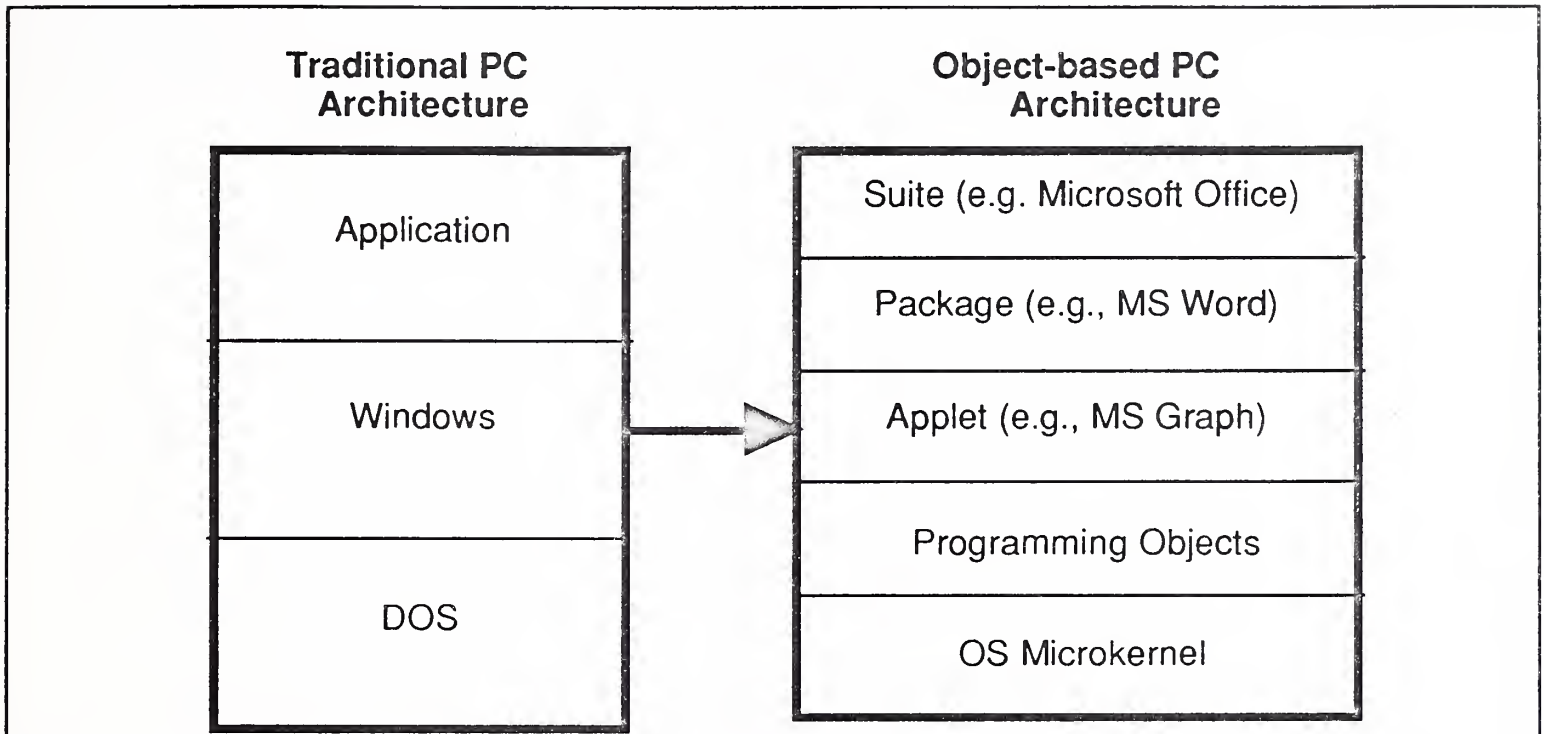
Systems have evolved so that Microsoft Office, a suite of packages, contains MS Word, MS Excel, MS Powerpoint and MS Mail. Each package is made up of applets, such as MS Graph, that can be shared among the packages. This is built from objects that then may run on an operating system microkernel. The full implementation by Microsoft of the bottom two layers will take



place in its CAIRO operating system, which includes the Windows NT kernel and objects from Windows 4.0.

Exhibit IV-3

### Client Operating Environment Trends



Source: INPUT

There is a trend to make the operating environment portable across multiple client machines and connect to servers with objects. This is NeXT's strategy with SunSoft for OpenStep. It is also Taligent's strategy for TalAE, its operating environment.

## 2. Multiple Personality Operating Environments

In the future, some argue that users will run multiple operating environments on a single microkernel, the heart of an operating system. This is sometimes referred to as a *multiple personality* operating environment. Already, Insignia's SoftPC family of products provides PC emulation on NeXTSTEP or MacOS. Also, OS/2 can support Windows and DOS.

Skeptics argue that users want a single integrated platform, the initial appeal of the MacOS. They note that an environment built on multiple objects will be harder for applications vendors to support than the proliferation of multiple versions of UNIX that has evolved. INPUT believes that there is room for both approaches, depending on the application. Users who need to interface with many organizations will need to support multiple environments; users with more limited requirements or low budgets will prefer to standardize on a single platform.

### **3. How Long Will It Take To Adapt To OO Environments?**

It took 10 years from Windows being announced at Comdex in 1983 to its widespread adoption. In the late 1980s, Windows was shipped bundled with applications like desktop publishing and document imaging systems, before it became today's PC standard specialized with 15 million users. Following this pattern, OO environments will be used for applications initially; by 1999, they will be used for many applications; and by 2004, environments like OpenStep and CAIRO will be widely available.

### **4. Will Any Competitor Threaten Microsoft's Installed Base?**

IBM will use the migration to OO environments to try to regain control of the desktop operating environment. It has a technically superior product to Windows 3.1 in OS2/2. However, IBM still has to prove to the masses that it has a viable alternative to Microsoft.

NeXT has a corporate mission to defeat Microsoft's CAIRO with NeXTSTEP. NeXT is small, nimble and energetic. It may dominate Microsoft in a few niche markets. However, unless it has a massive capital infusion or is acquired, it will be difficult for it to displace many CAIRO installations.

SunSoft and Hewlett-Packard (HP) are also potential competitors to Microsoft, although HP is less likely to market a portable operating system to hardware manufacturers. However, HP has invested heavily in objects and has a full complement of objects based on both Smalltalk and C++. These objects may run on standard operating environments like Windows and UNIX to lessen the market penetration of CAIRO.

## 5. Other OO Environment Trends

Other trends in OO environments are:

- Applications running on NeXTSTEP being more widely deployed in key vertical applications, such as financial services, telecommunications and health services, where they have helped companies compete by serving their customers faster
- Emergence of alliances built around Microsoft, Taligent and NeXT
- Increased emphasis on distributed processing and messaging
- Acceptance by both boutique and major services companies of the benefits of OO environments
- A cottage industry of object developers that can supply major integrators

---

## E

---

### Visual Development Tools

#### 1. Enterprise Support

Vendors of visual development tools are changing their focus from screen design to enterprise database support. This means that they must support multiple client workstations running UNIX, Windows, OS/2 and MacOS. They must either directly or via third parties provide tool support for the range of servers, server operating systems and databases found in major corporations, from mainframes to PCs. They must also be configured so that they run with reasonable performance on large installations of over 1,000 users.

#### 2. Code-Free Programming

Most of the tools support code-free programming to some extent—that is, they generate code to access databases without the user needing to understand SQL. Many can augment the automatic

programming with a 4GL or lower level 3GL, like Smalltalk or C++.

Exhibit IV-2 shows that in the past, design was undertaken on a CASE system. Visual development tools created the user interface. Now the visual development tools are adding support for system design using business objects. These represent objects familiar to the system designer, like name, company, address, expense report, and payments. Also represented are business processes that can be performed with the objects like bill paying, order processing, expense reporting and mail list fulfillment.

### 3. Other Trends

Other trends emerging are:

- *Interfaces to nontraditional databases*—Vendors will add more interfaces to support documents. For example, support for digital paper documents produced by systems like Adobe's Acrobat and No Hands Common Ground can be expected.
- *Management of stored procedures*—They started as small scripts that could be sent from a client to a server, to be executed by the database software. However, the debugging, management and tracking of stored procedures is under development in many organizations.
- *Traveling user support*—Interfaces to databases on mobile clients and remote links from portable computers to office servers will change the notion of a distributed database.
- *Animated user interfaces*—From ticker tapes showing stock prices to presentations with dynamic charts, active user interfaces displaying moving objects are already used in data processing for system management and trouble reporting. The use of these interfaces will grow.
- *Multi-dimensional database access*—Increasingly, client/server systems will support not only object-oriented databases, but also databases that can support multidimensional financial models like Essbase from Arbor Software. Microsoft's Excel spreadsheet often provides a user interface to such systems.

By 1999, users will want totally scalable systems that they can begin to program and then hand over to professional programmers to develop into an enterprise system. Today, if a user develops an application on a simple database management system like Claris's FileMaker or Lotus' Approach, it is very hard to scale it to support run-time systems, large user populations, or multidimensional data.

Product lines that provide support for technical users as well as enterprise systems can be expected by 1999. Some of these products may be created from alliances or mergers of existing vendors.

## F

---

### Object Databases

OO databases tend to be selected over relational databases for applications that:

- Use an OO development tool, such as VisualWorks, that maps more easily into an OODBMS than an RDBMS
- Would produce too many joins if modeled in a relational database
- Are based on objects that perform operations on or communicate with each other—for example, "object a sends a message to object b"
- Integrate multiple databases using encapsulation of the data and business logic as objects rather than connecting the databases directly
- Are not based on tables or forms
- Require higher performance than that found in a relational database
- Are built on an underlying network structure
- Represent applications built from components, such as CAD/CAE applications

The main trends in OO and object-relational databases are:

- Support for specific applications, e.g., document imaging, geographic information systems, and video services
- Alliances between OO database vendors and OO visual development tools vendors
- Improved user interfaces
- Increased use of networking and telecommunications applications
- Support for fault-tolerance, replication, and on-line backup and recovery

## G

---

### How Trends Affect Users and Vendors

#### 1. Effects on Users

User organizations want to:

- Describe computer systems in familiar business terms, leading to the use of business objects
- Access accurate information freely
- Modify systems rapidly when business changes
- Design their own user interfaces

Object-oriented technology fosters improved communications between IS groups and users. Users can create or redesign business processes using objects and IS departments can implement them rapidly with OO development tools.

The main effects on users will be:

- Need for workstation class machines: 32MB of memory will be needed in the average PC by 1999
- More integrated job functions with multiple tasks handled in a single suite of applications
- The need for extensive training in how to search for and use information, as well as in the use of software
- New categories of support staff to manage information and object integration

## **2. Effects on Corporate IS Departments**

IS organizations want to:

- Create applications that are managed as easily as those on a mainframe
- Ensure that systems are secure from viruses and hackers
- Re-use objects and standardize on platforms
- Design, test, create and modify applications using a single suite of tools that integrates high-level business processes with low-level programming and generates code automatically
- Eliminate duplicate development efforts

Corporate IS staff will need to manage an object infrastructure and provide object administrators, just as they provide database administrators. Users and IS need to communicate their roles and identify management responsibilities. INPUT research shows that IS staff are increasingly managing the infrastructure and users are contracting with outside firms that have expertise in object-oriented platforms to build applications.

Once the management issues have been identified, tools can be applied to define business objects and integrate systems or build new ones. This may require retraining programmers, system architects and user interface designers. To gain the full benefits of re-use, a mechanism for identifying system components that

are worth sharing must be developed. Companies will typically have both central and decentralized object repositories. Organizations are discovering that re-using small objects like buttons, windows and short lists is not worthwhile, as programmers can create them in less time than it takes to find them.

### **3. Effects on Software Vendors**

A vendor of OO software can decide to:

- Use object frameworks in-house as a competitive weapon to develop applications faster than competitors

or

- License object frameworks widely

The first strategy is appropriate if the vendor has expertise in a particular application that can give it a competitive edge. This is particularly true of systems integrators like Andersen Consulting, EDS, Martin Marietta and SHL Systemhouse.

The second strategy is appropriate for a packaged software vendor. Companies like Microsoft, IBM and Lotus will become publishers of objects that they may integrate with their other tools and applications.

### **4. Opportunities for New Services**

Bulletin boards, on-line services and kiosks can offer objects, software components and content to developers, users and systems integrators. The Object Management Group has recently announced that Connect, a California company, will license software objects via an on-line network service.

Franchising opportunities exist for professional services firms to expand their expertise. Porting services that move application packages from one object environment to another will grow, just as they did with the advent of UNIX. Network integrators that use object infrastructures will develop competitive advantages in solving network support and connectivity problems.



**H****What Is Likely To Happen between 1994 and 1999?**

---

The exhibits in this section show some plausible scenarios for events that may occur in the 1994-1999 timeframe. Each event has a probability of occurrence, based on opinion, industry experience with similar companies, and current competitive positions. For each scenario an explanation is given.

The operating system environment market is emerging. NeXT has been a software vendor only for two years; Taligent has yet to ship a product; Microsoft's OLE is out, but not as usable as many had hoped; and OpenDoc is just starting to emerge. Either users will be content with a tinker-toy approach to creating applications from multiple applets, or they will become frustrated with incompatibilities and will turn to NeXT or Taligent for an integrated consistent framework. Exhibit IV-4 discusses how the operating environment market could develop.

Exhibit IV-4

### Scenarios for Operating Environments

Scenario, Date and Probability of Occurrence	Explanation
<p>Microsoft Wins</p> <p>1998-1999      Probability 0.3</p> <p>NeXT and Taligent move their software to the Windows NT kernel.</p>	<p>Microsoft solutions prove viable; Windows NT and Windows are now reliable, multitasking environments. Workstations are moving from UNIX to Windows NT; Apple supports Windows as its mainstream platform.</p>
<p>OpenStep Is Successful</p> <p>1998-1999      Probability 0.5</p> <p>NeXT begins to be perceived as the user environment for Solaris, then for other versions of UNIX, then for other operating environments.</p>	<p>Users are dissatisfied with Windows for clients, viewing it as unsuitable for industrial-strength applications. NeXT provides superior tools and finds more hardware licensees; users find the OpenStep user interface more efficient and reliable. In the most successful outcome, NeXT would license its code to IBM and Apple, as well as running it on the Windows NT kernel as an alternative to CAIRO. A risk is that Sun might abandon OpenStep.</p>
<p>Taligent Is Not Widely Accepted</p> <p>1998-1999      Probability 0.7</p> <p>Users prefer to combine multiple tools rather than use new software provided by Taligent.</p>	<p>It will take 10 years for Taligent to become successful on the desktop with a complete operating environment, based on the take-up of other operating environments. Taligent can accelerate market acceptance by working with HP's and IBM's application support teams.</p>
<p>NeXT Fails as a Business</p> <p>1999              Probability 0.1</p> <p>Despite strong marketing and OEM relationships with Digital, Sun and HP, users are reluctant to support a different operating environment.</p>	<p>NeXT has a loyal customer base and a business model that is enabling it to grow. It is highly unlikely that NeXT would fail before 1999. It is more likely that Sun, Canon, or a software vendor like Novell will acquire NeXT before 1999.</p>

*Source: INPUT*

Visual development environments abound; there is intense competition and many companies will be acquired or will fail. The capital required to keep up with technology, gain widespread corporate acceptance and support aggressive marketing will increase. Exhibit IV-5 discusses how the visual development tools market could develop.

Exhibit IV-5

### Scenarios for Visual Development Tools

Scenario, Date and Probability of Occurrence	Explanation
<p>Microsoft Acquires Powersoft</p> <p>By 1998                      Probability 0.4</p> <p>Despite the widespread use of Visual Basic, FoxPro and Access, Microsoft does not have a tool equivalent to Powersoft.</p>	<p>Microsoft can be expected to acquire companies as it grows. Microsoft typically acquires companies smaller than Powersoft. For example, it acquired DOS, Powerpoint and font technology from embryonic companies.</p>
<p>Borland Becomes a Successful C/S Vendor</p> <p>By 1997                      Probability 0.3</p> <p>Borland would need to succeed with both dBase and Interbase for this to occur.</p>	<p>There is a latent demand for dBase for Windows, and Borland's superior technology enables it to woo FoxPro developers away from Microsoft. There is still room in the market for a relational database that is as simple as FileMaker, with scalability to the performance of Oracle. Borland, with dBase and Interbase, may have such a product.</p>
<p>At Least Five Tool Vendors Mentioned Here Fail</p> <p>By 1999                      Probability 0.8</p>	<p>Given the small size of some of the tool vendors mentioned here, this is a likely scenario as vendors each add more features. As selling to users becomes more expensive, many companies will have to rely on resellers for success and they will want to pick the winners. This means that users must choose vendors with standard interfaces.</p>
<p>All Significant Tool Vendors Either Are Part Of or Have Acquired a Database Company.</p> <p>By 1999                      Probability 0.9</p>	<p>Vendors can be expected to merge. Just as Powersoft acquired WATCOM and Borland acquired Interbase, acquisitions are expected to increase.</p>

Source: INPUT

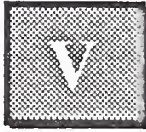
The ODBMS market is starting out much more slowly than the development tools market. This is partially because of difficulty in understanding how the databases should be used.

Exhibit IV-6

**Scenarios for ODBMSs**

<b>Scenario, Date and Probability of Occurrence</b>	<b>Explanation</b>
<p>Illustra Is Larger than Any of the Existing ODBMS Vendors Today.</p> <p>By 1999                      Probability 0.8</p>	<p>The company has a seasoned management team and is solving problems of object storage for specific applications. It is able to articulate a marketing vision more clearly than are some of the OODBMS vendors.</p>
<p>Oracle, Informix or Sybase Acquire an OODBMS Vendor</p> <p>By 1997                      Probability 0.7</p>	<p>The established database vendors have the distribution and support needed by the ODBMS vendors. They cannot solve all problems using their existing engines, and as OODBMS vendors run short of capital they could be attractive acquisition targets.</p>
<p>User Interfaces Become Customized for Vertical Markets for Each of the Major OODBMS Vendors by Resellers.</p> <p>By 1997                      Probability 0.9</p>	<p>Already, OODBMSs are used for vertical applications and some have resellers that create customized user interfaces. It is highly likely that a few niche resellers will emerge that can match the recent growth of Powersoft or ParcPlace.</p>

*Source: INPUT*



## Issues

Issues and concerns are identified for each software category. This section reviews criteria for implementing OO systems, including migration strategies from legacy systems. It shows the strengths and weaknesses of an object-oriented approach.

### A

---

## Key Issues for Object-Oriented Environments

Key issues for developers in OO environments are:

- Which components should they assemble? Which should they build?
- Which class libraries should they support? Will they get locked into a class hierarchy in the same way that developers became locked into hierarchical databases in the 1970s, and not be able to modify their application easily?
- Will pricing be usage based on public networks? Will the pricing be different if the software runs on public networks? Will metered usage pricing be prevalent on corporate networks?
- Which OO tools have royalty-free run time versions?

INPUT believes that highly customizable applications, consisting of applets that can be easily configured and integrated with existing environments, will become standard. Systems integrators need to develop specialized objects for their market to succeed.

The major concern raised by NeXT users was the desertion by major software vendors of the NeXT platform. Most felt that the benefits of the NeXT development environment outweighed the

inconvenience of not being able to use standard packages like WordPerfect.

The CORBA standard for object exchange is not a panacea. As users start to install CORBA-compliant systems they will find that they cannot send an object from A to B without understanding information about B's environment. Seamless integration of systems using CORBA will be slow to emerge. This provides an opportunity for software vendors.

## B

---

### Key Issues for Object-Oriented Visual Development Tools

For OO development tools the key issues are:

- Which companies will survive the market shakeout? Which will become aligned with major database vendors? Which will remain independent, providing access to all major databases?
- Do users have to pay for run time licenses? If so, for which components?
- Which products are most appropriate for certain classes of applications?

## C

---

### Key Issues for Object-Oriented Databases

For OO databases the key issues are:

- Will they become mainstream products or remain as niche products?
- How do they scale? Can they compete with low-end relational databases like FoxPro and Paradox, or with high-end relational databases like Oracle and DB2? If so, can they provide a scalable solution?
- Are enough programmers trained to use them?
- Will traditional database vendors like Oracle, Sybase, IBM, Informix and Computer Associates modify their existing databases to support objects as easily as OO databases?

- Are systems management tools available? The lack of such tools has been an impediment to the deployment of ODBMSs until now. OpenVision, Tivoli, Legent and Candle can be expected to deliver such tools.
- Can they be run on high availability platforms? UNIX platforms are only just now supporting high availability systems with clustered disks. Because ODBMSs are typically written on UNIX systems it is only now that they can be used in high availability configurations.

## D

---

### When Are Object-Oriented Platforms Appropriate?

Moving an application to run on an OO client environment is most appropriate when:

- An organization can afford to train programmers in development tools for OO clients
- The application needs to be rapidly developed, and time to market is critical
- Users gain productivity from the style of user interface

Moving to a complete operating environment like NeXTSTEP is most appropriate when:

- System users do not need to access existing Windows applications when they are using the system
- A multi-threaded, multi-tasking client operating system is required
- The application frameworks remove complexity from the design and implementation of the new application
- The application is more complex to develop using standard Windows or UNIX tools than in the new environment

Using OO databases instead of relational databases is favored when:

- Queries tend to be based on navigating through a network of data, rather than a bulk query of the form:  
"SELECT people WHERE age >18"
- Data is modeled in nontabular structures or is more easily modeled as a network, as found in telecommunications applications
- The structure of the database may change
- Transactions may be lengthy and include significant programming logic
- To use a relational database would mean linking many tables

## E

### Migration Strategy

Legacy applications may be integrated into an OO application using the techniques and products described in Exhibit V-1.

Exhibit V-1

#### Strategies for Migrating Legacy Applications Using Objects

Strategy	Representative Products and Vendors
Identify fragments of COBOL code and "wrap" them so that they appear to the GUI development tool as objects.	<ul style="list-style-type: none"> <li>• Digitalk's PARTS with Micro Focus's COBOL wrapper</li> <li>• Trinzic's ObjectPro or AionDS</li> </ul>
Connect relations in relational databases to objects in a GUI development tool.	<ul style="list-style-type: none"> <li>• Easel's Synchronicity and Enfin, parts of Object Studio</li> <li>• NeXT's DBKit and NeXTSTEP</li> <li>• ParcPlace's VisualWorks using Object Lens</li> </ul>
Use an OO database to store or locate information from legacy databases.	<ul style="list-style-type: none"> <li>• ADB's M.A.T.I.S.S.E.</li> <li>• Servio's Gemstone with GeODE</li> </ul>
Embed business rules as objects in COBOL or another 3GL code.	<ul style="list-style-type: none"> <li>• Trinzic's business rules</li> </ul>

Source: INPUT



**F**

---

**Strengths and Weaknesses of an Object-Oriented Approach**

The strengths and weaknesses of using an OO approach are summarized below.

**1. Strengths**

- Integrates frameworks with consistent programming interfaces
- Hides complexity from users and programmers
- Provides ability to customize designs
- Provides greater range of data types

**2. Weaknesses**

- OO tools do not enforce the benefits of OO techniques; the objects and software modules must still be managed.
- Developers can get locked into complex hierarchies of code. For example, NeXT for many years could not unbundle its user interface from lower operating system code. This hindered its ability to license it widely to other UNIX vendors. Advantages of integrating the applications software with lower level objects are that the software can re-use common components and display a consistent user interface. With SunSoft, NeXT expects to overcome these barriers to widespread implementation.
- New language training is involved for lower level OO software, such as Smalltalk in ParcPlace's VisualWorks or Easel's Enfin.
- Experts with both Smalltalk application and knowledge are hard to find.

The benefits in coding efficiency and system flexibility usually far outweigh the disadvantages of OO systems, which are generally minor.

## G

---

### Standards

The main standards that influence the deployment of object-oriented client/server systems are:

- ODBC—an interface that client software uses to access databases. The standard is promoted by Microsoft. Some view it as a lowest common denominator interface. Most vendors aim to provide native interfaces to leading databases like Oracle and Sybase. ODBC is useful for smaller LAN installations.
- SQL3—a database language from ANSI X3H2 and ISO committees targeted for completion in 1997. It will support complex data types.
- CORBA and COSS—specifications for object exchange between systems from the Object Management Group.
- OQL—an ODBMS query language that is being defined by the ODMG, with other interfaces to ODBMSs.

*De facto* standards from vendors, such as Microsoft's OLE and ODBC, are emerging. Lotus's Notes/FX standard for integrating document parts and OpenDoc from CIL will be the main competitors.



# Market Analysis

## A

---

### Market Description

#### 1. Barriers to Entry

Barriers to entry for OO platform vendors are:

- An installed base
- Committed programmers in both large and small organizations
- Design wins on future hardware platforms
- Many compatible software frameworks
- First-class internal development tools that enable platforms to be enhanced quickly

#### 2. Object-oriented Environment Market

This is an emerging market. The three main contenders for the next generation operating environment are Microsoft, NeXT and Taligent.

Microsoft is only vulnerable if Chicago and CAIRO prove unreliable in handling communications-intensive client/server environments. Microsoft has first-class support for its developers, so even if there are problems Microsoft can resolve them without losing customers.

The predominant OO operating environment on the market today is NeXT's NeXTSTEP. Software engineers may prefer OO operating systems because they enable code to be consistent between different parts of the system. As NeXT discovered, users

rarely want to replace an entire operating system. NeXT is working with SunSoft (a subsidiary of Sun Microsystems) to develop OpenStep, a version of NeXTSTEP that runs on Solaris (Sun's version of UNIX). OpenStep is expected to ship in 1995.

Taligent, a joint venture initiated by Apple and IBM, started as an internal Apple project to create an OO operating system known as "Pink." Taligent decided that rather than market an entire operating system initially it would market development frameworks. Both NeXT and Taligent developers claim that their environments enable programmers to create applications quickly and reliably. Taligent has released PEEK, its software development kit, to at least 100 sites initially.

IBM has OS/2 and, as an investor in Taligent, is the strongest potential competitor to Microsoft. Apple, with the MacOS, is working with IBM on the PowerOpen architecture to support the PowerPC. The main thrust is to start by adding OpenDoc to integrate documents on MacOS. Novell, with UNIX, is a key player that can provide solutions on both Novell network servers and by enhancing UNIX. Sun, with Solaris, is working with NeXT on the next generation of UNIX development frameworks, OpenStep. However, the greatest competition could come from the consumer market, where OO operating systems for set top boxes and PDAs could move into the commercial arena.

Initially, the impact on client/server systems will be evident in the client environment. Operating environments from the above vendors will supply rich user interfaces.

### **3. Visual Development Tool Market**

This is a rapidly growing, fragmented market that is ready for a shakeout. There is a wealth of OO tools for developing client/server applications.

Smalltalk-based tools, like ParcPlace's VisualWorks and Digitalk's PARTS, are gaining acceptance in commercial markets. Programmers frequently choose tools based on familiarity with the underlying language. Those familiar with SQL are more likely to work with Powersoft's PowerBuilder or Gupta's SQL Windows. Those familiar with Smalltalk and interested in creating visually exciting screens are likely to be attracted to ParcPlace's and Digitalk's tools.

In reality, for many applications the difference between these tools is small. The underlying network architecture is a key factor in determining the suitability of tools for larger projects. The differentiating features are speed with which code can be developed, quality of interfaces to databases, range of platforms supported, and run time performance.

The development tools market can expect price erosion, with tools for user programming priced at \$99 to \$300 per seat and tools for professional developers being priced at \$1,000 to \$3,000 per seat in 1996. By 1999, these prices are likely to have fallen to about \$60 for each user seat and \$300 for each programmer seat. Modular packages will evolve and additional interface modules will be priced separately. Tools like Forté that operate across enterprise networks will continue to command higher prices.

#### **4. Object Database Market**

This is another emerging market. After growing slowly, and then doubling in 1993, many vendors in this market have recently received additional infusions of venture capital. This is based on their opportunity for acceptance in more mainstream commercial applications and the growth of areas like telecommunications network management, which were once considered small niches but are now significant markets. Price erosion in the ODBMS market is not likely to be as steep as in the visual development tools market. The market for ODBMSs will continue to grow and will not reach maturity until after the turn of the century.

## **B**

---

### **Vendor Revenue Share**

#### **1. Operating Environment Vendors**

It is not possible to estimate the market share of Microsoft, Taligent and NeXT, as only NeXT is shipping an integrated operating environment product. Also, the real competition from Microsoft to Taligent and NeXT are objects running on top of Windows. It is difficult to forecast the market for objects using the methodology of this report.

Exhibit VI-1 shows revenues for systems software vendors. This is the portion of the company's revenues attributable to U.S. sales for software licenses. The first column gives the company name,

followed by U.S. systems software revenues for calendar year 1993. The estimated growth in this revenue is shown in the third column. The growth rates are estimated on the previous year's growth rates, the company's market position and product strength. The company's 1993 worldwide revenues are shown in the fourth column, together with 1992-1993 annual growth rates.

Exhibit VI-1

### Systems Software Vendor Revenues, 1993-1994

Company	U.S. Systems SW Revenues	Growth Estimate	Worldwide Revenue	Growth Worldwide
	Calendar Yr. 1993	'93-'94	1993	'92-'93
	(Estimated \$M)	%	(Estimated \$M)	%
IBM	2,175	-15	62,700	-3
Microsoft Corp.	721	15	4,109	26
Novell, Inc.	530	20	1,100	22
Sybase	305	60	427	61
Apple Computer	450	10	7,900	10
Borland Int'l	207	-12	459	-12
Lotus Development	120	50	981	9
KnowledgeWare	81	-12	126	-7
Powersoft Corp.	52	200	57	118
Gupta Corp.	27	18	56	71
Easel Corp.	20	10	27	-18
ParcPlace Systems	20	100	23	134

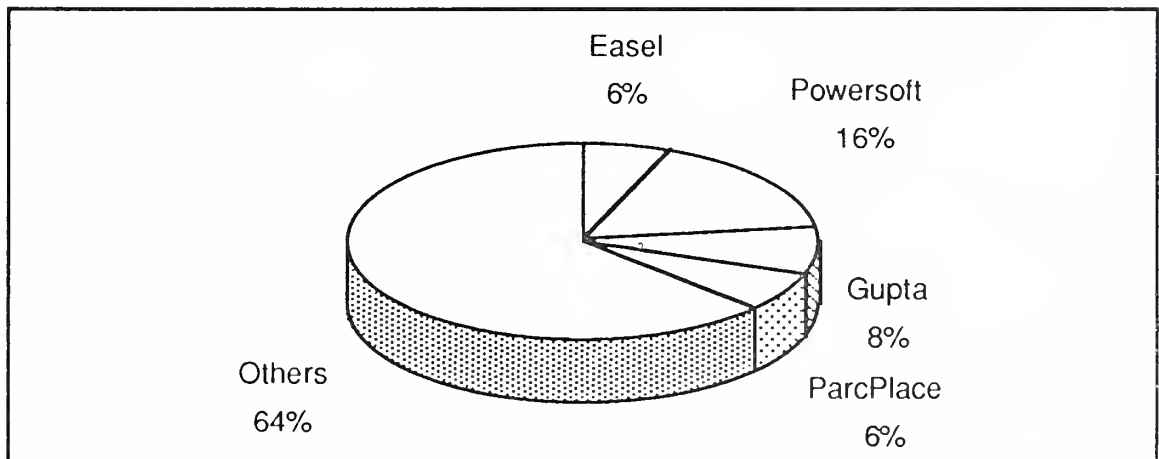
Source: INPUT

Exhibit VI-2 shows the relative share of vendors' systems software revenues in the U.S., based on INPUT estimates for 1994. Vendor revenues are estimated for the U.S. market in 1994 at \$460 million and in 1999 at \$1,650 million. Service revenues are excluded.

The revenues used to create Exhibit VI-2 includes sales from tools that develop visual environments across networks, like Forté. Easel's revenues include those from its ESL event-driven product line and its ObjectStudio object-oriented product line. Powersoft's revenues do not include those of WATCOM, the database company that it acquired. Gupta's revenues include those for its SQL Windows client software as well as its SQLBase server database. ParcPlace's revenues are almost all for Smalltalk-based visual development tools, the remainder coming from server Smalltalk licenses and C++ development tools that have ceased to be mainstream for ParcPlace. Included in others are Microsoft's Visual Basic revenues and other vendors with object-based or object-oriented client development tools.

Exhibit VI-2

### Visual Development Tool Vendors' U.S. Revenue Share, 1994

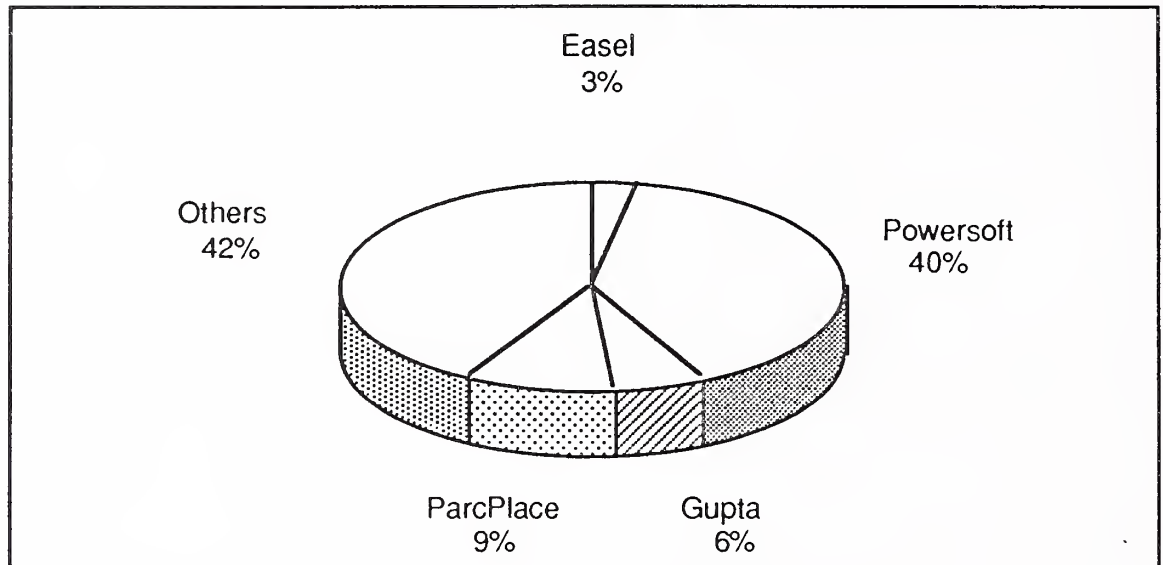


Source: INPUT

ParcPlace is expected to continue its lead over Easel in object-oriented software. This is because ParcPlace had higher growth rates than Easel in 1993. However, Easel has a strong management team and is strongly promoting its products. It is also stronger than ParcPlace in its support for business objects. Gupta is assumed to have lower growth rates than Powersoft because Powersoft has more retail distribution.

Exhibit VI-3 shows the projected vendor share based on revenues from U.S. software licenses in 1999.

Exhibit VI-3

**Visual Development Tool Vendors' U.S. Revenue Share, 1999**

Source: INPUT

Exhibit VI-4 shows the revenue share for object database companies, out of an estimated total of \$150 million in 1994 to \$970 million in 1999. Exhibit VI-5 shows the corresponding numbers for 1999.

Exhibit VI-4

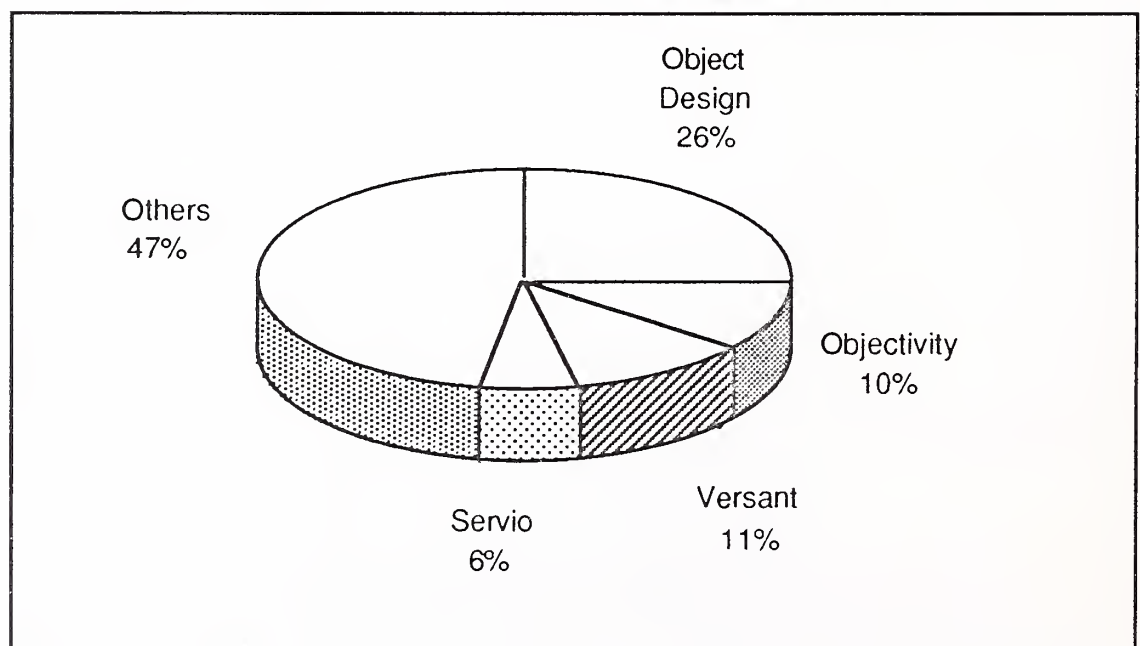
**Object Database Vendors' U.S. Revenue Share, 1994**



Exhibit VI-5

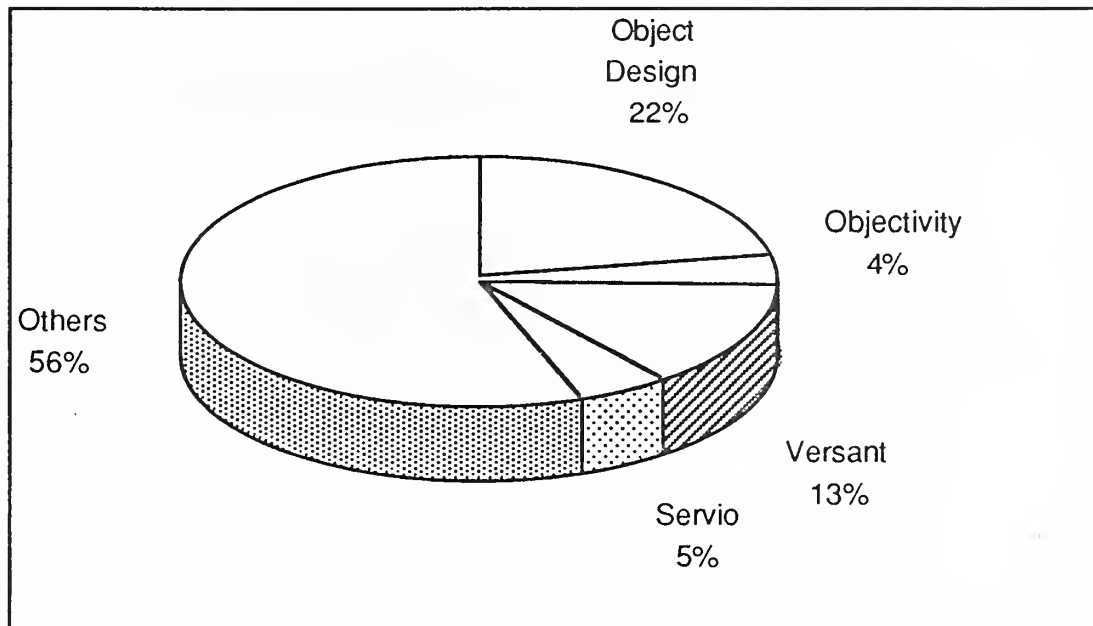
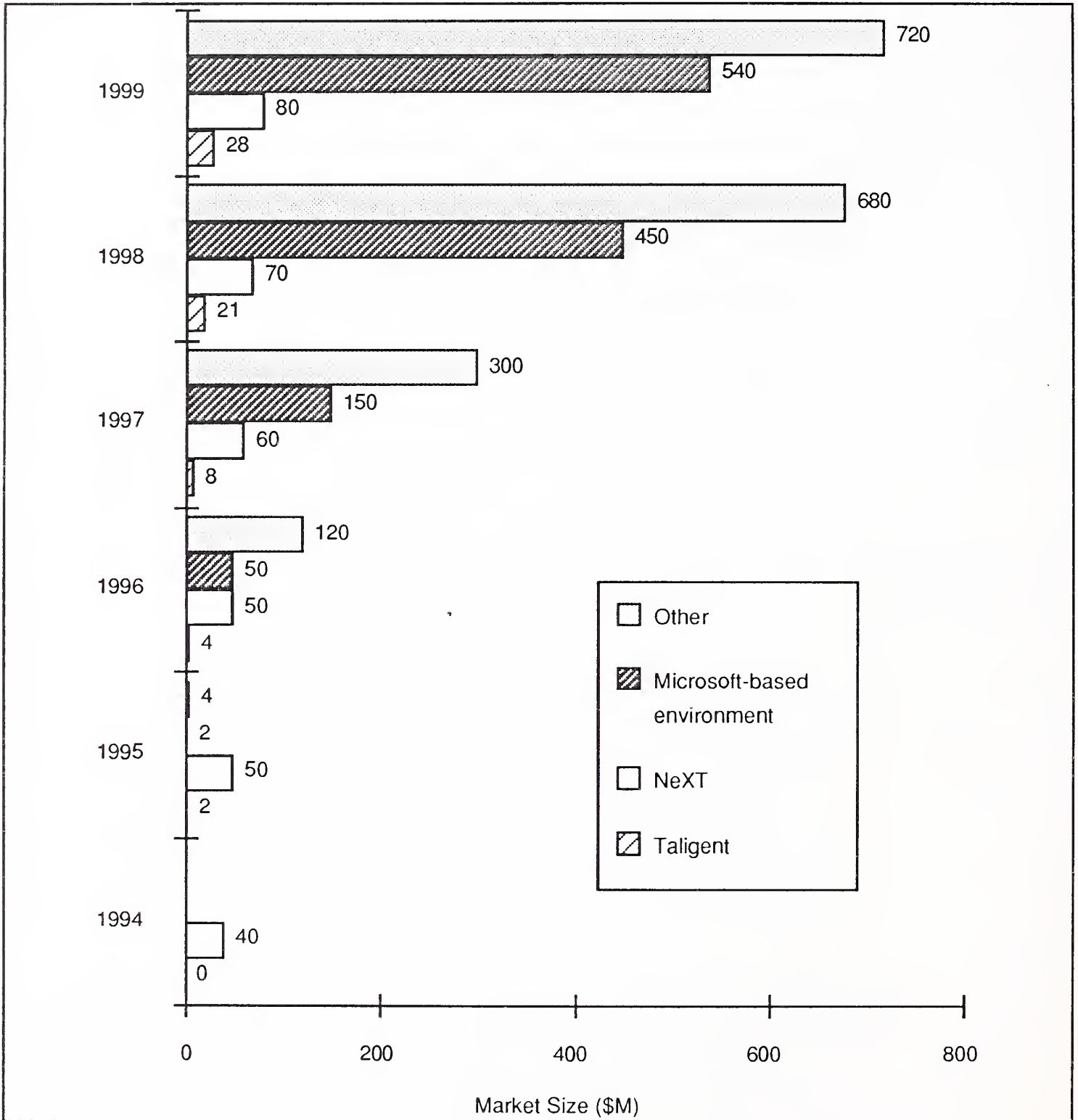
**Object Database Vendors' U.S. Revenue Share, 1999***Source: INPUT***C****User Spending****1. Operating Environments**

Exhibit VI-6 forecasts the spending on operating environment software from three vendors: Microsoft, NeXT and Taligent. The category "other" includes environments from IBM and others. The "other" category excludes the portion of user licensing fees paid to NeXT and Taligent, but may include, for example, IBM's Workplace on an OS/2 kernel. User spending does not include consulting, system integration or training fees.

When Microsoft enters the market with CAIRO, competition is expected to be fierce, particularly in high-performance workstations and communications-intensive environments. NeXT is expected to grow steadily, but not spectacularly, and Taligent revenues may see slower-than-anticipated growth. This is because it takes time for companies to adapt to radically different ways of programming.

Exhibit VI-6

**Worldwide User Spending on Client OO Environments**



Source: INPUT

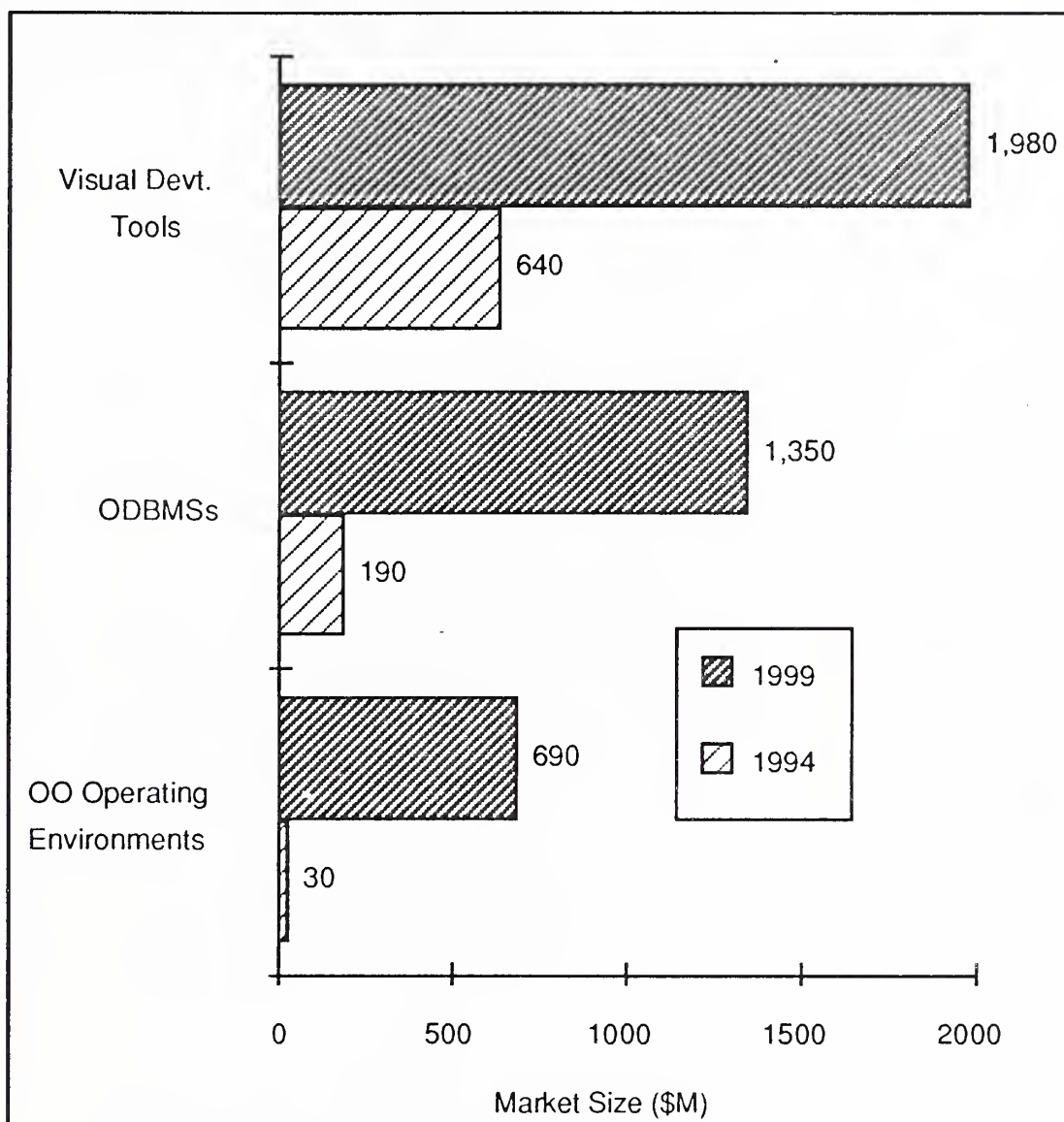
**2. OO Platforms**

User spending for each platform category is shown in Exhibit VI-7. As can be seen, object databases will be a major factor by

1999. However, OO technology will still be predominantly used in tools that can create a visual user interface.

Exhibit VI-7

### User Spending on OO Platforms—U.S. 1994-1999

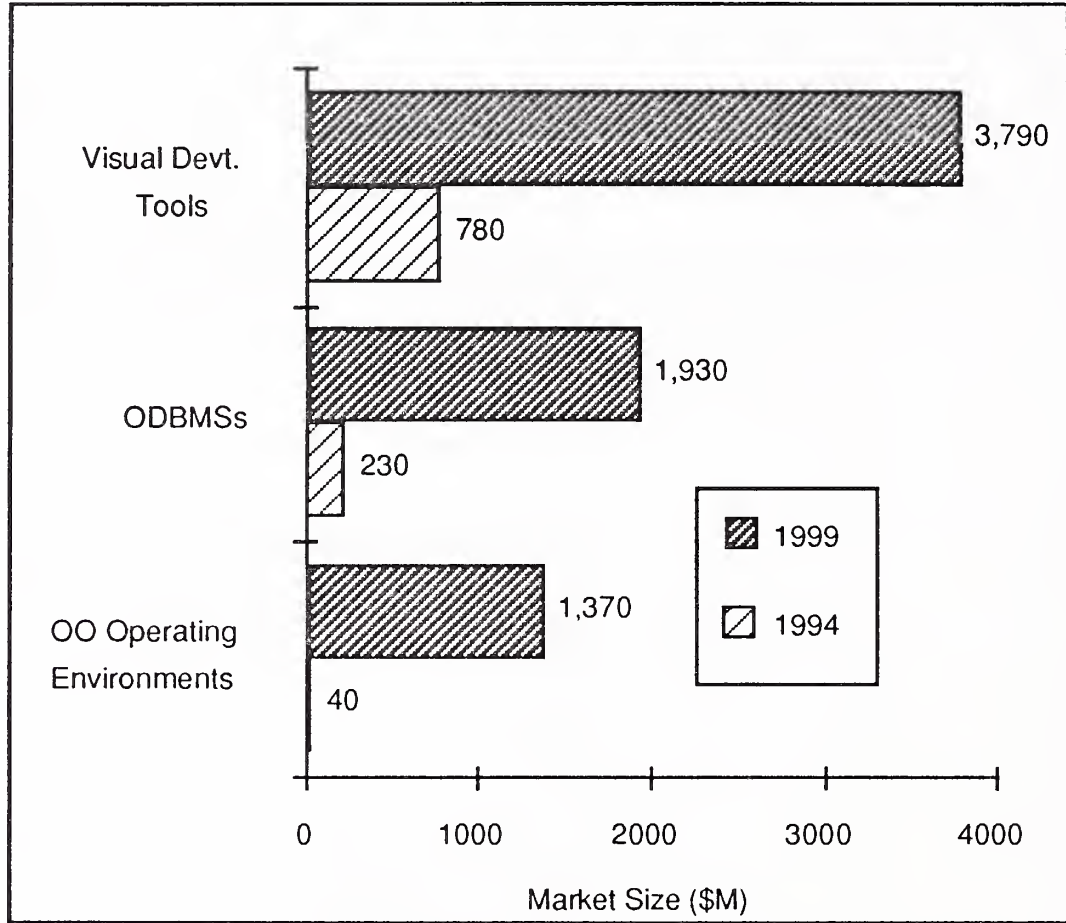


Source: INPUT

Exhibit VI-8 shows worldwide user spending by software category on OO platforms, including the above numbers for client environments, object databases and visual development tools. Initially, objects will be used more in visually driven development environments than for databases. The growth of object databases overseas is expected to be considerably smaller than in the U.S.

Exhibit VI-8

**User Spending on OO Platforms—Worldwide 1994-1999**



Source: INPUT



# Customer Analysis

This chapter considers the key characteristics of successful customers. It lists some applications that use OO platforms.

## A

---

### Key Customers

#### 1. Customer Characteristics

Typical customers for object-oriented platforms are those that must provide services or answer problems quickly and are prepared to invest. Financial services organizations need to be able to create new algorithms for analyzing investments and take in real-time wire feeds. Cellular phone operators like McCaw and CANTEL need PCs in retail stores that can provide telephone service connections instantaneously. A store clerk has to be able to handle a job previously handled by telephone company experts. Medical institutions need to integrate devices with visual displays to get instant diagnoses. Retailers must be able to order instantaneously.

#### 2. Critical Success Factors

Customers that have successful installations have the following characteristics:

- A lead system architect and programmers familiar with both the application and the OO tool
- A commitment to the project by senior management
- A project of significant visibility and size. If the project is too small it will not get noticed, and if it is too large it may never get done.

- A willingness to modify code constantly as the development is under way
- Software that can support the programming team and encourage object re-use

## B

### Typical Applications

Exhibit VII-1 shows representative applications in vertical markets that have been integrated or developed using OO platforms. In the first column, it describes the market and vendor. In the second column, it describes the application, followed by size and configuration details in the third column. The final column provides costs and benefits.

Exhibit VII-1

#### Applications Built Using OO Platforms

Market and Vendor	Application	Size and Configuration	Costs and Benefits
Business Services (NeXT)	Office automation, programmer support.	Not available	Reliable desktop workstations. Weaknesses are lack of standard applications, but the increase in productivity and ability to support the services offered outweighs this disadvantage.
Process Manufacturing – Brewery (Digitalk)	Stock management system to keep track of beer pallets until they reach one of over 100 warehouses.	Server is OS/2-based DB2/2 database, with a mainframe DB2 database. Digitalk PARTS was used. 50 classes, 2,000 methods, 2 windows, 30 DB2 tables, 50 DB2/2 tables with 700 columns.	Took 3 months to build with 5 people and runs 7 days a week, 24 hours a day; the mainframe could not provide this because of maintenance outages. Did not have time to fully implement visual user interface.

Exhibit VII-1 (cont'd)

Market and Vendor	Application	Size and Configuration	Costs and Benefits
Manufacturing (Sapiens)	Order entry	600 users, 100 DB2 tables, 6,000 Sapiens rules, average throughput of 60,000 transactions with response times of less than 1 second.	Maintenance requirements are cut by as much as 70%. Users can provide rapid feedback to development team.
Oil & Gas (Neuron Data)	Make seismic data accessible to explorationists using Oracle database	100 users.	Decentralized operations, PCs and Suns replace mainframe.
Distribution (Magic)	Inventory management	100 DOS and Windows PCs, Tricord server, Netware.	\$300,000 annual savings in administration and licensing costs compared with mainframe. Faster response to RFQs.
Banking (Magic)	Mutual fund accounting	Multiple systems, UNIX, ASCII terminals, and PCs distributed across multiple sites. Over 200 funds to manage.	Could sell an additional product line: fund accounting. Programming time reduced from 2 years (COBOL) to 6 months.
Financial (Neuron Data)	Trading applications: pricing and portfolio analysis, reviewing market prices.	50 screens, 80 users on VAXs and PCs.	Multi-threaded access to real-time data feeds. Software cost \$217,000. Portability.
Insurance (Easel)	Underwriter new policy review	Enfin is on OS/2 with access to Sybase and IMS databases on UNIX and a mainframe.	Can query Sybase in SQL, more rapid processing time, faster time to issue new policies that need to be reviewed by an underwriter.
Insurance (Magic)	Policy administration	3,000 modules, 450 database files. NetFRAME server with 112MB memory, 20GB storage.	Five people in 1.5 years estimated equivalent to 100-150 COBOL mainframe programmers taking 3 - 5 years. Downsized from mainframe to NetFrame, saving \$1M a year.

Source: INPUT

This section shows that the main benefits of OO platforms are savings resulting from faster programming, lower cost computers and automation of a business process. There are also savings in software licensing costs on smaller systems. Portability of OO applications, better communication about business processes by IS and users, and integration of operations are other benefits of OO applications.





## Vendors

This chapter reviews vendors, their distribution and support strategies, and their strengths and weaknesses.

### A

#### Product and Vendor Summary

Exhibit VIII-1 shows the vendors of client OO environments. The first category shows companies that will use objects running on existing operating systems. The second category shows technology vendors that license software to others. The third category shows hardware manufacturers that expect to build products using technology from NeXT and Taligent.

Exhibit VIII-1

#### OO Environments—Vendors and Products

Systems Software Category	Vendors	Products
Based on Traditional Operating Systems	Apple IBM Microsoft Novell Taligent	MacOS with OpenDoc OS/2 evolving into Workplace with SOM and DSOM Windows with OLE 2.0 Netware, Appware, UNIX TalAE
Based on Integrated Frameworks	Microsoft NeXT Taligent	CAIRO NeXTSTEP TalAE
Based on Acquiring Integrated Frameworks	Apple Canon, Digital, NEC, Sun HP IBM	Maybe TalAE NeXTSTEP on PCs or OpenStep  OpenStep TalAE and OpenStep, NeXTSTEP native

Source: INPUT

Exhibit VIII-2 shows the vendors of visual development tools. The tools have been classified in column one according to their primary differentiation based on their evolution.

Exhibit VIII-2

### Visual Development Tools—Vendors and Products

Systems Software Category	Vendors	Products
Driven by Need to Program Windows Better Using 4GL	Gupta Powersoft Sybase	Quest, SQLWindows PowerBuilder, PowerMaker Build <i>Momentum</i>
Driven by CASE Interfaces	KnowledgeWare	ObjectView
Driven by Compatibility with Terminals	Magic Software	MAGIC
Driven by AI-based Rules Interfaces	Intellicorp Neuron Data Sapiens Trinzic	Kappa, Object Management Workbench (CASE tool) Open Interface Elements Ideo ObjectPro and AionDS
Driven by Smalltalk	Digitalk Easel IBM ParcPlace Servio	PARTS, Smalltalk/V ObjectStudio, Synchronicity, Enfin, TeamWorks VisualAge VisualWorks GeODE
Driven by Integration	Forté Sybase	Forté Enterprise <i>Momentum</i>
Driven by information retrieval needs.	Open Data	FindOut!
Driven by Multimedia Support	Fujitsu Sybase	IntelligentPad GAIN <i>Momentum</i>

Source: INPUT

Exhibit VIII-3 shows object databases and their vendors.

Exhibit VIII-3

### Development Tools—Vendors and Products

Systems Software Category	Vendors	Products
OODBMSs	ADB Objectivity ObjectDesign ONTOS POET Software Servio Versant	M.A.T.I.S.S.E. Objectivity/DB ObjectStore ONTOS DB POET GemStone Versant
Interfaces between OO Client Software and Databases	HP Persistence	Oadapter and OpenODB Persistence
ORDBMSs	illustra UniSQL	illustra UniSQL

Source: INPUT

## B Vendor Strengths and Weaknesses

### 1. ADB

#### *Strategy*

ADB sells M.A.T.I.S.S.E., an OO database that interfaces standard relational databases to CASE tools, such as IDE's Software Through Pictures. It uses an OO development methodology, such as GE's Object Modeling Technique (OMT). M.A.T.I.S.S.E. was originally developed to support banking applications because existing databases were not fast enough. The software is designed to provide high-performance transaction processing. ADB is a French company, although the original database was developed in the U.S.

### *Strengths*

- Fast, responsive company with Internet support
- Technically strong—designed for mission-critical 24-hour operation, supports OLTP, transparent on-line recovery and media fault-tolerant. Can support 400MB transactions to monitor nuclear power station activity.
- Data management and administration support, in particular database size, can be enlarged while it is running.
- User can extend the data model, which is OO, providing rules, triggers at object, attribute or relationship level.
- Scalable from a few bytes to 4GB per object, up to four Giga-objects per database.
- Modular—MATISSE Client Object Oriented Services Libraries (API), MATISSE Server Engine Libraries (API), MATISSE Server Engine, MATISSE DB Administrator Tools, MATISSE Object Editor, MATISSE Object Browser.

### *Weaknesses*

- Not many platforms are supported: Sun, VAX, HP-UX for database, Windows and MacOS additional for clients.
- Weak U.S. marketing and market positioning
- Poor choice of supercomputer partner, Kendall Square Research

### *Outlook and Assessment*

ADB must position itself more strongly in the U.S. market; otherwise, it will be overcome by UniSQL and HP. It needs stronger partnerships and alliances.

## **2. Apple**

### *Strategy*

Apple is focusing on making the PowerPC platform a success. It is strengthening the Macintosh operating system development and licensing its platform to third parties. OpenDoc, a competitor to Microsoft's OLE, is a cross-platform technology licensed from Component Integration Laboratories to integrate document

components. This will run on the MacOS. Apple will not support an OO operating environment until System 9, probably in 1996 or 1997. The next MacOS release is System 7.5, which supports OpenDoc.

### *Strengths*

- Highly visible publicity and event marketing
- Low-cost networking suitable for sharing small files and printing
- Well integrated, easy-to-use computers
- OpenDoc will provide strong support for multimedia and documents, where Apple has strong applications.
- Financially, the company is rebounding from lower margins in 1993.

### *Weaknesses*

- Lacks understanding of the complete hardware and software solution required by customers; strong on innovative technology, weaker on customer requirements
- Marketing is not focused on solution sales; Apple prefers to leave that to dealers.
- Reduction in third-party software evangelism. Apple has recently stated that it was a mistake to reduce its support for software vendors. Lotus has indicated that it will not program for the MacOS. Microsoft's Office was released significantly later on the Mac than on Windows.
- Apple needs developers that can build turnkey systems for small businesses as well as the existing packaged software developers.
- Weak distribution of development tools. Apple sells its development tools through APDA, its development software reselling arm. Developers not in the Macintosh community find it difficult to understand how to buy software tools, unlike Microsoft developers, who can find tools.



### 3. Borland

#### *Strategy*

Borland has developed dBase for Windows as its object-oriented client database that can interface to Interbase, its server database. Borland is in a risky financial situation, but recently sold Quattro Pro to Novell to raise capital and enable it to focus on object-oriented C/S solutions. Its financial viability depends largely on the success of its object-oriented strategy and on dBase for Windows. Borland can be expected to unveil suites of development tools based on objects.

#### *Strengths*

- Strong engineering and technology
- Code is generally reliable
- Strong retail and mail order distribution
- dBase for Windows has been well-received for its technical features by programmers. It remains to be seen whether they will commit to it as a development platform.

#### *Weaknesses*

- Some products are priced too low.
- Financial risk is high, as the company has not yet seen high revenues from its new dBase product line.
- Borland was late to develop database products for the Windows market.

#### *Outlook and Assessment*

If Borland can gain back developers who have moved to FoxPro and Access databases from Microsoft, it has an opportunity to regain its position as a premier database vendor. However, competition from Microsoft will be fierce, which will lead to a price war. Borland must respond by positioning its features better, and emphasizing value without reducing its prices too much. Borland's opportunity lies in providing a scalable solution that enables users to program with the same software as those building enterprise solutions.

## 4. Digitalk

### *Strategy*

Digitalk started as a Smalltalk vendor and has focused on indirect distribution through resellers to programmers. The company also works with VARs and SIs. It provides an inexpensive Smalltalk environment on PCs, Smalltalk/V.

### *Strengths*

- Low-cost entry-level products
- Joint marketing with IBM on AS/400 platform to transform legacy applications into client/server systems
- Supports CICS using its PARTS wrapper technology to embed legacy code in C/S systems
- High-quality advertising and public relations
- Products created with Digitalk tools are royalty-free.
- Support for Windows NT and Win32
- Team/V provides support for programming teams.

### *Weaknesses*

- Small, privately funded
- Less portable than ParcPlace's Smalltalk. Digitalk's advantage is that it compiles to the native Windows, Macintosh and X-Windows environments to provide a look and feel unique to each platform, rather than the same look on each machine. This enables it to take advantage of platform-specific features, such as OLE.
- Most support is indirect, via E-mail or the CompuServe forum. Corporate users who are used to one-hour response times may find it difficult to deal with Digitalk if they need to speak to a person.

### *Outlook and Assessment*

Since Easel acquired Enfin and ParcPlace went public in early 1994, the corporate market has become more competitive for Digitalk. Digitalk needs capital to compete in this market.



However, with strong support from independent developers and marketing partners like IBM, Digitalk has the opportunity to be the leading vendor of Smalltalk-based tools for small business and departmental applications. Digitalk is leveraging its CICS and AS/400 connections, but it needs to continue to build relationships with IBM and systems integrators.

## 5. Easel

### *Strategy*

Easel's original product, Easel, took mainframe terminal data and displayed it under Windows so that it could be integrated into PC applications. As this market matured and users wanted more applications programming in their user interfaces and more complete development tools, Easel acquired a second product line that has been developed to form its Object Studio line of products.

Easel thus has two approaches to client/server computing. For users that want to retain their infrastructure, Easel offers the original ESL product line. For users that want to program in objects, Easel offers three main components to its Object Studio line:

- Synchronicity—business object modeling tool integrated with Enfin
- Enfin—Smalltalk-based development environment
- TeamBuilder—support for programming teams and version control based on Intersolv's PVCS

Synchronicity is based on business objects and enables developers to design the logical connections between elements of an application. Enfin is a Smalltalk development environment.

Object Studio competes with ParcPlace's VisualWorks. Easel tends to be stronger in East Coast mainframe accounts, whereas ParcPlace has stronger connections with the UNIX community and West Coast mainframe accounts.

*Strengths*

- Having two product lines means that Easel has a range of products to offer corporate applications developers.
- Easel understands the support needs of corporate developers and aims to get back to support requests within an hour.
- Easel provides royalty-free distribution within a company of applications built with Object Studio. This is an advantage in getting an installed base of developers, but may put Easel at a financial disadvantage in the long term.
- Object Studio is initially being deployed in banking and insurance applications.

*Weaknesses*

- Needs a more leveraged approach, with more VARs and system integrators
- Had unstable financials after the initial Easel product was insufficient to compete against PowerBuilder and SQL Windows. The company is trying to bounce back with Enfin.
- No electronic mail support, although a CompuServe forum is supported
- The application is created from business objects; this is appropriate for large organizations, but may be less appropriate for smaller workgroups where applications are prototyped from screen designs.
- No support for the MacOS. Development has focused on OS/2 and Windows, with some UNIX platforms supported.

*Outlook and Assessment*

As the OO client/tools market grows, Easel should see success in markets with which it is familiar, such as banking and insurance.

- Easel needs to engage more third parties that can create development frameworks for vertical markets. It needs stronger partners to sell indirectly.
- Easel is focusing on tools. It needs greater expertise in business processes for long-term differentiation, possibly concentrating on banking and insurance with IBM.

## 6. Forté

### *Strategy*

Forté's strategy is to provide a cross-platform development tool that links databases. It is particularly useful for applications that require interaction between multiple databases. Users have been requesting that a single vendor supply tools to accomplish database integration, GUI design and application development. Forté promises to fill this niche. Forté has raised \$20 million in venture capital.

### *Strengths*

- High-level management team from Ingres, Candle, Servio, Sybase, Oracle, Banyan and Control Data
- Strategic partnerships with leading hardware vendors
- Large commitments from initial sites

### *Weaknesses*

- Software is not widely available.
- Software has not been packaged in modules yet and a low-end distribution policy has not been established.
- Products may be too high priced to attract individual developers like Microsoft and Powersoft.

### *Outlook and Assessment*

Forté's strategy is in line with the general trend to connect different databases using messaging. A brief review of its tools reveals that the company will make networked software development easier. The main tests for the product will come in 1994 and 1995 as the early beta sites start to run commercial applications. Based on its initial reception in beta sites and the

ability to show cost savings for development teams, the company should grow to at least \$20 million by 1996. This is assuming the company undertakes training and consulting and attracts distribution partners.

## 7. Fujitsu

### *Strategy*

Fujitsu has announced IntelligentPad, an application development tool that develops a GUI interface to databases and supports multimedia. This was originally developed in the University of Hokkaido in Japan, and has been licensed by several vendors.

### *Strengths*

- Open architecture that enables the tool to be augmented by software components
- Over 50 developers
- Modular approach

### *Weaknesses*

- Fujitsu is not perceived as a software vendor. It will be hard to market the product in the U.S. because of competition from Sybase with Gain/Momentum.
- Fujitsu needs a strong VAR program.
- It is not well differentiated.

### *Outlook and Assessment*

This appears to be an academic effort that needs to be fully commercialized. Fujitsu may find internal use for the product and with its hardware customers. The product is more likely to be successful in Japan than in the crowded U.S. market. The product is likely to fail in the U.S. and Europe unless Fujitsu markets with hardware from Amdahl or ICL. If Fujitsu licenses it to a leading systems integrator or software publisher, such as a database vendor, it may be successful.

## 8. Gupta

### *Strategy*

Gupta provides both client software (SQLWindows) and server software (the SQLBase database). SQLWindows 4.0 was marketed as an OO system. With SQL Windows 5.0, the first release to incorporate "Quick Objects," Gupta has simplified the creation of user interfaces. Traditionally, Gupta has had a very powerful data entry screen and forms creation capability in SQL Windows, but its system has not been easy to learn. "Quick Objects" represent:

- Visual screen elements (Visualizers)—buttons, check boxes, scroll boxes
- Database interfaces (Data Sources)—to access databases with user control of commands
- QuickForms—form templates
- Interfaces to nontraditional data objects, such as Lotus Notes, electronic mail systems, images, and videos

This approach is not unlike that supported by ParcPlace's VisualWorks. Gupta is moving to higher end functionality by improving support for distributed systems and large-scale development.

### *Strengths*

- Experienced management with many executives, including Umang Gupta, drawn largely from Oracle
- Support for collaborative programming—source code control, project management, template libraries for screens and forms. This helps promote code re-use.
- High growth—revenues grew 71% to \$56.1M in fiscal 1993
- Has both database and GUI tools
- Strong technology—technology pioneer in client/server Windows tools; interfaces to legacy systems, integrates DLLs, and compiles SQL code for performance

- Alliances with Cincom to resell software and with Novell to package Gupta's products for Novell resellers

### *Weaknesses*

- Price erosion—Gupta is not as well positioned with retailers and mass-market distributors as Powersoft. To counteract pricing pressure, Gupta is giving away free copies of its low-end software for client application development.
- Management of growth—Gupta's revenues grew 71% to \$56.1 million in 1993, with profits doubling for the year to \$5.6 million. To finance this growth and maintain market leadership against Powersoft, Microsoft and Sybase, Gupta may require greater resources than are currently available.
- Aging user interface—SQL Windows was one of the first application development tools for Windows. The programmer interface has been improved in SQLWindows 5.0. However, it still lacks the visual appeal of PowerBuilder.

### *Outlook and Assessment*

Recent speculation that Oracle may attempt a hostile takeover of Gupta was fueled when Oracle increased its stake in the company to 7.7%. However, it then promptly sold two-thirds of its holdings. Gupta remains an acquisition target for Oracle. The benefit to Oracle of such an acquisition would be a set of development tools that Oracle could use to compete with Microsoft and Powersoft. Oracle would also acquire an installed base.

Novell is another possible buyer. Novell invested in Gupta in April 1990. Novell would benefit from adding SQLBase to its product line as it positions itself to compete with Microsoft in networked databases.

Gupta is increasing its performance and networking capabilities to play in the networked database market. As Microsoft has gained a following of developers that supply VBX controls, Gupta is looking to both corporate developers and a cottage industry of small programming firms to build on its position in the mid-range. There is opportunity for Gupta to grow, provided it increases its indirect distribution channels so that it can reach more developers. Gupta can acquire partners, or be acquired by a company that can sell Gupta products alongside its own offerings.

Gupta has an agreement with KnowledgeWare to bundle its single-user SQLBase engine with every copy of ObjectView. This should give SQLBase wider exposure in corporate development environments.

## 9. Hewlett-Packard (HP)

### *Strategy*

HP's strategy is to support the leading OO software packages. It has marketed OpenODB to connect relational databases to OO languages and has recently announced Oadapter. Oadapter is intended to link Oracle 7 to OO applications. OpenODB, like UniSQL, has found applications in the oil and gas industry.

### *Strengths*

- Corporate commitment to objects—investment in Taligent, OEM arrangement with NeXT, licenses for ParcPlace's Smalltalk, support for OO DCE, CORBA-compliant ORB Plus object request broker, and HP Fusion OO design methodology
- Strong research group in OO databases
- Expertise in Distributed Smalltalk and strong product frameworks for developers (SoftBench) and network administrators (OpenView). HP is well positioned to serve the corporate developer market with OO database technology. Oadapter is integrated with HP Distributed Smalltalk.
- Oadapter includes Enterprise Data Access, to create objects that support Information Builders' EDA/SQL gateway, thereby enabling applications to connect to more than 50 databases.

### *Weaknesses*

- OpenODB was not a large business for HP. Because HP has so many other products it is hard for the company to make it a major focus. OpenODB is, however, being marketed as a key component of HP's distributed object strategy.

### *Outlook and Assessment*

Although HP is not a leader in OO databases, with its investment in OO technology it is likely to become a major player. HP is an investor in Informix, and that is one partner with which it may

work more closely to expand its presence in the relational database market. Alternatively, by maintaining a neutral position, HP sells machines running Sybase and Oracle.

## 10. IBM

### *Strategy*

IBM has many object-oriented strategies. IBM classifies its products and services under the following headings:

- Enablers and tools
- End-user environment
- Distribution services
- Components

IBM's aim is to provide services, education and an industry focus. Its Object Technology Practice, part of the IBM Consulting Group, provides consulting services to major corporations. It recently announced that its Workplace OS, an OS/2-based operating environment that would support various object-oriented frameworks, would be renamed Workplace.

Taligent's TalAE will initially run on IBM's UNIX operating system, AIX. IBM also expects it to run on OS/2 and the AS/400 family of systems. OpenDoc is another OO IBM strategy for combining document elements.

Another initiative is to build an enterprise architecture based on distributed software components—DSOM (Distributed System Object Model).

In addition, IBM has a competitor to Easel's Object Studio and ParcPlace's VisualWorks in VisualAge with IBM Smalltalk, an OO development tool. VisualAge initially runs on OS/2, which will limit its market acceptance. IBM will integrate Envy/400, a Smalltalk release control system, as ParcPlace has done, to support team programming. VisualAge is marketed from IBM's Software Solutions Division.

IBM has worked with Object Design on OO databases. Given its installed base of legacy data, IBM is more likely to connect these



with objects, rather than promote a pure object-oriented database strategy at this time.

### *Strengths*

- AIX and OS/2 operating environments that can support objects. Also, the PowerOpen initiative provides IBM with an industry standard hardware platform for supporting object-oriented systems.
- Size, global support and scalable platforms from PCs to mainframes
- Many mainframe and AS/400 sites that can be connected to PCs and workstations using objects
- Strong marketing of Workplace and DSOM; strong commitment to objects
- Strong initiative to make objects interoperable
- DB2 provides a family of relational databases that support mainframes, OS/2 and AIX.

### *Weaknesses*

- Multiple platform initiatives for mid-range servers—OS/2, AS/400, AIX
- VisualAge is not supported across a wide range of platforms.

### *Outlook and Assessment*

For applications that require an object-oriented environment, IBM is the only company that can really provide a strong challenge to Microsoft. By teaming with Apple, IBM has built up considerable expertise on low-end platforms. IBM may not be a leader in Smalltalk environments, because of its late entry into the market. With SOM and DSOM, IBM promises to be a leader competing with HP and Sun in distributed object environments.

## **11. Illustra**

### *Strategy*

Illustra (formerly Montage and before that Miro) is an emerging, venture-funded company that has taken the PostGRES database

from the University of California at Berkeley and commercialized it. Founders include Roger Sippl, founder of Informix, Gary Morgenthaler, an investor in Ingres, and Michael Stonebraker, founder of Ingres. Hence the company has been able to attract a strong management team, led by Dick Williams, former President of Digital Research, a PC systems software developer.

The strategy is to develop a database engine that is extensible. Customers can add data types.

### *Strengths*

- Sales team experienced in OEM and indirect sales strategies to leverage the business
- Strong marketing
- Support for SQL-3 and standard database interfaces

### *Weaknesses*

- Developed on Sun UNIX initially; needs to support Mac, OS/2 and Windows

### *Outlook and Assessment*

Illustra has a window of opportunity. Sybase and Oracle will add object-oriented features to their products. Sybase 10, with Gain's software, supports objects and Oracle 8 is expected to support objects.

The real value that Illustra provides is not so much the object technology as the implementation of the technology for specific object families. Illustra integrates useful software libraries, called DataBlades, for image processing and geographical information systems. These tools vastly simplify development of applications in these areas—the software libraries provide a standard foundation that is extensible.

Illustra is a strong company. Its success will depend on the quality of its VARs, integrators and OEMs, initially. If it can encourage developers to add DataBlades for specific applications, it will provide a highly productive development environment.

## 12. Intellicorp

### *Strategy*

Intellicorp is known for its expert system development tools; capitalizing on its expertise, it has created a visual development tool. Object Management Workbench (OMW) develops applications on Sun OS and HP-UX, UNIX systems. It also can run on Windows. It is based on James Martin's Martin/Odell methodology. It was developed using Kappa, Intellicorp's OO visual programming environment.

### *Strengths*

- Support for business rules
- Relationships with James Martin & Associates, consultants, and HP
- Strong support for large commercial sites
- UNIX presence—Intellicorp's tools support leading database vendors like Oracle, Sybase, Ingres and Informix

### *Weaknesses*

- Intellicorp's marketing is too technology oriented—it needs more applications and vertical market focus.
- Developers need to understand the Kappa environment to gain full productivity from the Object Management Workbench.
- The company needs more presence in the PC and Windows markets.

### *Outlook and Assessment*

Intellicorp has a strong development environment using its Kappa development system. This system has been developed over the last ten years and the company needs a more modern image.

## 13. KnowledgeWare

### *Strategy*

KnowledgeWare intends to be acquired by Sterling Software. KnowledgeWare is promoting ObjectView as its client/server OO

development tool, having acquired it from Matesys. ObjectView 3.0 is being promoted to user programmers, rapid application developers, consultants and value-added resellers. ObjectView supports visual programming, a BASIC-like language, and enables C or C++ routines to be added. It is an object-based application that competes with PowerBuilder and SQLWindows. ObjectView Desktop is an entry-level version of ObjectView.

KnowledgeWare has also bundled the ClearAccess report writer with ObjectView. Building on relationships with its customers for CASE tools, KnowledgeWare provides extensive training, consulting and seminars.

### *Strengths*

- High-quality partners and systems integrators; works with Powersoft and Gupta
- Intense public relations and direct mail campaigns to developers, including \$199 introductory pricing for ObjectView Desktop (list \$3,499)
- ObjectView creates applications very quickly. It can be integrated with KnowledgeWare's ADW CASE tool.
- Strong interfaces to mainframes and legacy data
- Simple programmer interface via a single editor in ObjectView and faster performance for some applications than PowerBuilder or SQL Windows

### *Weaknesses*

- Financial performance has been uneven as a result of fast growth and product transitions.
- KnowledgeWare's image remains linked to CASE tools related to IBM's unsuccessful AD/Cycle enterprise development efforts. To counteract this, recent direct mail campaigns have featured neon colors and racing cars. However, these still do not portray the company as a market leader. The company needs new positioning.
- ObjectView is a little late to the market—there is already intense competition that must be overcome.

### *Outlook and Assessment*

Sterling Software's acquisition of KnowledgeWare is likely to be positive for both companies. It provides Sterling with object-oriented technology and major accounts, as well as a strong support team. It provides KnowledgeWare with capital, increased distribution opportunities and a sales force knowledgeable in software tools and enterprise computing. The challenge for Sterling will be to position KnowledgeWare's ObjectView in a winning position against Gupta and Powersoft.

## **14. Magic Software Enterprises**

### *Strategy*

Magic is an emerging vendor with a client/server tool for retrieving data from multiple databases. The tool produces forms-based screens on UNIX, DOS, Windows and ASCII terminals. Hence the displays are not visually rich, but functional. The approach to coding is to fill in forms, based on an OO environment that includes fields, tasks, operations, data, views and programs. MAGIC, its key product, is particularly useful when older PCs must be supported in a client/server system. The company had approximately \$12 million in revenues in 1993, with about half from the U.S., \$2 million from Israel and \$2 million from Japan.

### *Strengths*

- Supports PCs with limited memory (640K) and minimal disk storage requirements (2.5MB)
- Simple, rapid application development—programmers are prompted with pull-down menus that are easy to learn
- Supports a wide range of UNIX platforms: IBM, Digital, Sun, Silicon Graphics, Data General, HP, AT&T, Unisys, and Olivetti. Also supports Unisys's CTOS, Netware, DOS and VMS.
- Supports over 18 languages, including Russian, Chinese and Japanese

### *Weaknesses*

- Visual appearance is like that of an ASCII terminal, even on Windows

- Code is interpreted and not compiled, slowing performance
- Little corporate visibility

### *Outlook and Assessment*

Magic provides a pragmatic solution for corporations that want to access data from multiple databases and do not want to upgrade client PCs. It enables ASCII terminals to be readily added to a client/server system.

Long term, the company will have to upgrade its user interfaces. However, given the installed base of existing terminals and the rapidity with which applications can be developed, this product fills a niche.

## **15. Microsoft**

### *Strategy*

Microsoft used many features from OO development in its Windows development environment, which is the reason that Windows applications are generally referred to as object-based. Without an approach to programming based on objects, Windows would have been more difficult to develop. However, Windows is not generally thought of as fully OO because Windows applications cannot be modified without being recompiled. However, Windows developers that use software libraries (DLLs) as components in their architecture are close to an OO implementation. They can re-use the DLLs and replace them if their interfaces are documented.

Therefore, despite Microsoft developing OO operating systems internally, the real strategy for Microsoft is to gradually migrate users to component-based software by integrating objects on top of the Windows family of operating systems. Just as Microsoft introduced Windows on top of DOS, Microsoft can be expected to introduce more OO features gradually. The next version of Windows, Chicago, will enable applications to extend it with objects.

In 1996, Microsoft is expected to release SQL Server for CAIRO, an object-oriented database. It is expected to provide an object repository, Object File System integration (that is, integration with

CAIRO's file system), support for OLE and distribution across networks.

Microsoft's goals are to:

- Move into the corporate data center with software for servers like the SQLServer database and enterprise messaging, selling corporate database software at unprecedented low prices
- Provide a scalable solution from WinPad-based palmtop devices to Windows NT-based enterprise servers
- Provide software that supports documents as collections of objects, such as charts, pictures, tables of contents, headers, footers, video, sound and text
- Integrate application components using OLE (object linking and embedding), integrate enterprise applications with messaging and link computers to telephones

Microsoft's development tools have already fueled the development of component software in five major forms:

- Dynamic Linked Libraries (DLLs)—used by Windows programmers to develop program components. These will become more customizable over time. They are typically used by packaged software vendors.
- Visual Basic Controls (VBXs)—used by Visual Basic developers and adopted by database and application development tool vendors to customize Visual Basic applications. The Visual Basic Controls are the components of Visual Basic that bear the most resemblance to OO programming, with inheritance and modularity that leads to their re-use. Microsoft's strategy is to encourage VBX developers to reprogram their code as OLE code so that it can be embedded in more applications.
- Applets such as Microsoft Graph—users of Microsoft Office observe common software modules such as Microsoft Graph that draws charts. Vendors that have benefited from developing applets are fax modem software vendors, such as STF.

- Object Linking and Embedding (OLE)—initially used as a programmer's "cut and paste" to take components from one application and use them in another application. With OLE 2.0, the programmer libraries enable sophisticated applications to be built from applets.
- User-created objects like charts, tables and forms—user content is currently a small part of a system and typically managed in files. Increasingly, electronic filing cabinets for different types of objects will emerge.

### *Strengths*

- Evolutionary strategy—users migrate to objects slowly, first using OLE, then moving to CAIRO
- Large installed base
- Strong distribution and marketing
- Wide range of system and application products that already depend on common components and reusable code

### *Weaknesses*

- OLE 2.0—this is being perceived as a Windows solution, rather than a cross-platform solution like OpenDoc, despite Microsoft's intention to support it on other platforms such as the Apple Macintosh. The initial version of OLE had limited use because of its poor performance and lack of software for user support. User applications could more effectively use "cut and paste" instead of OLE. OLE currently is used by some systems integrators to interface databases and spreadsheets into applications or for linking information into presentations and documents.
- Windows is still an unreliable operating system because of weak task scheduling and restrictions imposed by the PC memory architecture. These drawbacks increase programming complexity. Chicago promises a single memory model, multi-tasking, and hot peripheral switching. If this system is unreliable for networked multi-threading applications, developers probably are going to switch to UNIX systems from NeXT, Sun, HP and Digital more readily.



### *Outlook and Assessment*

Despite NeXT and Taligent trying to dent Microsoft's leadership position, the real competitors are IBM, Sun and Novell in systems software. Clearly, Microsoft has the dominant installed base for client platforms. Microsoft is creating an OO operating system—CAIRO. CAIRO is not expected to replace Windows 4 (Chicago); rather, it will use the Windows 4 look and feel with the Windows NT kernel. This makes it more likely to succeed as a workstation operating environment than one for the mass market. The combination of OLE and CAIRO will compete with Taligent, but will use Windows Objects. Microsoft's approach is to encourage developers to use its Component Object Model. This is based on taking existing Windows code written in C++ or C or Visual Basic, and creating an object from it.

Microsoft's focus in major corporations is to:

- Solidify its enterprise marketing and sales efforts
- Become a major player in the mid-range database market
- Sell Windows NT on multiple hardware architectures and platforms

Microsoft is likely to be very successful in client/server database markets with SQL Server, because of its ability to sell at low entry prices. It will interface systems using OLE and messaging. Microsoft's risk is that it will not be perceived as a viable enterprise systems vendor, and that its image will be for low-end systems.

## **16. Neuron Data**

### *Strategy*

Neuron Data's GUI development tools, Open Interface Elements and C/S Elements, are marketed with NEXPERT OBJECT, a rules-based development tool. Customers usually buy Neuron Data's products when they need to develop GUIs but also need to support business rules using an expert system. SMART ELEMENTS integrates the user interface building tools with the rule-based engine.

*Strengths*

- Portable—over 35 platforms are supported, including major UNIX platforms, VMS, MVS, Windows NT, Windows, MacOS and OS/2
- Installed base of NEXPERT users
- Strong language support, with internationalization framework and Japanese and Korean

*Weaknesses*

- Focus is split between user interfaces and rules processing; the company failed to become a leader in GUI development.

*Outlook and assessment*

Neuron Data needs to gain more recognition with developers and users. Its systems tend to be perceived as requiring sophisticated understanding of business rules and logic. This has prevented them from being more widely adopted. Developers that understand artificial intelligence, expert systems or logic have been attracted to the product. Neuron Data needs to focus on a few key applications and publicize its success in developing them, rather than focusing on broad markets. The company should rely less on NEXPERT OBJECT's technical features in its promotions.

## 17. NeXT

*Strategy*

NeXT's strategy is to provide an alternative to Microsoft as an application platform for both PCs and workstations. NeXT is committed to producing tools that can create applications more efficiently than other methods. Having dropped hardware manufacturing to concentrate on complete operating environments, NeXT is leading the industry in OO operating environments. NeXT has recently licensed objects for UNIX servers (PDOs) that connect to NeXTSTEP clients.

*Strengths*

- Strong vision for vertical markets and future direction as a vendor of OO technology; strong public relations
- Well-integrated, powerful tools for native interfaces to Oracle and Sybase databases
- Consistent, efficient user interface. Postscript display provides identical screen image to printer image for documents. Also provides smooth scrolling and zooming. Internals of UNIX are hidden, although experts can run UNIX shell commands. Single-button mouse operations mean few human errors are made, in contrast to a traditional Motif UNIX user interface, where three-button mice can make commands confusing.
- Productive, enthusiastic customers
- Responsive technical support by phone, fax, electronic mail and bulletin boards
- Cottage industry of objectware vendors
- Memory management, multi-tasking and multi-threading in the operating system mean a significantly more robust environment than Windows or MacOS. Also, the system supports real-time feeds.
- Value-packed development system—the user code takes up over 200MB of hard disk storage and the basic development system provides over 100 MB. The functionality is far more than that found in Windows with either Visual Basic or Visual C++ from Microsoft.
- 1993 sales are estimated at \$11 million for NeXT, and first quarter 1994 sales were \$8 million. It will be hard for NeXT to sustain this growth without more OEM partners; however, the financial trend is positive.
- The Enterprise Objects module provides support for business objects.
- NeXT's strong training program recognizes the roles different developers need to play in an OO development team.

### *Weaknesses*

- Lack of drivers for PCs—only a few SCSI controllers, fax modems, display boards, compact disk drives, and sound boards work with NeXT software.
- Does not plug and play well with Windows. PC users have two options: to reboot their machines when they want to run NeXTSTEP, or run a package like the SoftPC from Insignia solutions on top of NeXTSTEP.

### *Outlook and Assessment*

NeXT has an extraordinarily strong product, technically. As a client/server development environment it has built-in support for networking and database interfaces. If it had been marketed in Apple as the successor to the MacOS or parts of the environment had been marketed as the standard desktop UNIX earlier, it could have been successful. However, at the time, the powerful PCs required to run NeXTSTEP were not cost effective, NeXTSTEP was hard to unbundle, and NeXT was focused on selling hardware.

NeXT needs to run on Microsoft Windows and be truly cross-platform to succeed. If it does not do this, then other frameworks from the Windows development market or IBM will eventually encroach on its markets.

NeXT is trying to keep ahead of the development tools market. If it can use its technology to develop superior tools faster than the competition, it will continue to find niche buyers. NeXT is successfully focusing on key niches. Its relationships with SHL Systemhouse, HP and Canon should help it gain market share. For a systems integrator, NeXT is a cost-effective UNIX development environment.

## **18. Novell**

### *Strategy*

Novell's UNIX will continue to evolve, as it has done in the past, with participation from hardware manufacturers on its features and implementation priorities. Object-oriented tools may reside on UNIX, but major changes to the operating system from Novell to make it object-oriented are not likely soon. This is because UNIX has a modular architecture that, while aging, is flexible and can support scalable systems with reusable code.

Appware, Novell's application development tools for distributed applications, will be its strategy in visual development tools.

### *Strengths*

- New management, with Robert Frankenburg from HP as CEO
- Both Netware and UNIX have a large installed base that Novell can sell into.
- Novell is debt free.
- Strong developer support. Novell has successfully encouraged developers to create modules that are supported by Appware and Netware.

### *Weaknesses*

- UNIX is an evolutionary operating system—Novell needs to mount an aggressive marketing strategy if it is not to lose sites to Windows NT.
- Novell needs to have a strategic focus; it needs to provide a scalable range of networking tools that can support small enterprises as well as major corporations.

### *Outlook and Assessment*

Novell has a large Netware installed base that is vulnerable to Windows, as Windows gains more networking features. Novell needs to support a range of networking architectures with its tools. Given the complexity of network environments, Novell's expertise and its Appware strategy, Novell should be well positioned to create a range of development, messaging and systems management products for LANs.

## **19. Object Design**

### *Strategy*

Object Design Inc. (ODI), the largest OO vendor, doubled its revenues last year. It has raised almost \$40 million in venture capital since it was formed in 1988. It develops and markets ObjectStore, an OODBMS. Applications include telecommunications network management, process control,

financial modeling, geographic information systems, manufacturing design and cataloging, CASE, MCAD and ECAD.

### *Strengths*

- ObjectStore offers high performance.
- It supports Windows, OS/2, UNIX and Windows NT.
- ObjectStore has on-line backup.
- Object Design Storage technology is being used to support SunSoft's Distributed Object Environment (DOE).
- Object Design has a business relationship with IBM.

### *Weaknesses*

- The company has had significant venture capital, and until 1993 was slow to grow.
- Its product's entry-level price is high at \$3,500 per concurrent user.

### *Outlook and Assessment*

Object Design has a promising OODBMS. It is the market leader. Its relationship with IBM should help leverage sales.

## **20. Objectivity**

### *Strategy*

Objectivity has raised \$20 million so far in venture capital, receiving its last infusion in April 1994 of \$4 million. It started by focusing on the engineering market with its Objectivity/DB OODBMS. Its database has been accepted in the engineering, manufacturing, finance, transportation and telecommunications markets, to mention a few. Objectivity/DB supports leading UNIX platforms, Windows NT, Digital's OSF/1 and OpenVMS.

### *Strengths*

- Strong OEM marketing—Forté and Sybase are using Objectivity/DB
- Scalable technology to support gigabytes of objects and high performance
- First OODBMS to support both ANSI-standard SQL with SQL-3 extensions and Microsoft's ODBC to interface with standard client applications development tools. SQL technology is licensed from Dharma.
- Replication for fault-tolerance, reliability and distribution across networks

### *Weaknesses*

- Objectivity's direct sales visibility is not as strong as that of established database vendors. To grow, Objectivity may need a greater service and support organization.

### *Outlook and Assessment*

Objectivity/DB has been well received technically. Objectivity needs more VARs and systems integrators. It has strong OEM relationships and these should help finance its growth. Objectivity also needs to consider setting up an applications group or increase its services and support.

## **21. ONTOS**

### *Strategy*

ONTOS (formerly Ontologic) had one of the first OO databases. Its aim is to provide extensible databases for distributed workgroups. Its main products are ONTOS DB, a fully distributed OO database, ONTOS ESM, an extensible storage manager to access external data, and ONTOS R.O.A.D., a rapid application development environment that supports SQL, GUI building, schema creation, browsing, database connections and C++ interfaces.

### *Strengths*

- Frank Cary, former IBM chairman, has joined the board.
- ONTOS is working with academics to stimulate the research community.

### *Weaknesses*

- The system is relatively hard to use.
- Marketing is weak.
- It supports relatively few platforms—Sun, HP, IBM, Intel (UNIX, Windows NT and OS/2).
- The company has tried to provide its own user interface, but may have been better off partnering with vendors like Easel and ParcPlace.

### *Outlook and Assessment*

The company needs better marketing and more alliances with user interface tool vendors. Once it has simplified its interfaces it will be able to attract a larger following of VARs and systems integrators.

## **22. Open Data**

### *Strategy*

Open Data aims to make SQL interfaces transparent to business users and provide software using a user interface building tool, *FindOut!*. The company was called Open Books, but changed its name as it changed to support the database market. The company recently raised \$10 million in venture capital to support its product launch. *FindOut! Analyst* is a decision support tool and *FindOut! Builder* enables programmers to create a dictionary of the business that supports queries. IS managers can also tune the software to match network topologies. The software supports multidimensional data analysis.



### *Strengths*

- Low entry price of \$995 for the user version of Find Out!
- Experienced management team and president
- Supports Windows, OS/2 and Macintosh clients
- Software can be customized to support an environment by creating Business Dictionaries that model the business using objects.
- *FindOut!* was extensively tested by users before being launched.
- Interfaces between results of queries and spreadsheets like Excel; support for multidimensional data is provided

### *Weaknesses*

- Established tool vendors like Gupta, with Quest, and Powersoft, with PowerMaker, are introducing products for the business user. Despite a strong technology, there may not be room for Open Data in the market.

### *Outlook and Assessment*

Open Data has a tool that makes searching across multiple databases easy for the user. The company needs to continue to develop relationships with resellers so as to establish itself. It needs to position itself away from the "friendly user interface" market into the "data interpretation" market. This is so as to differentiate it clearly from Gupta and Powersoft.

## **23. Oracle**

### *Strategy*

Oracle's main thrust is to store objects in its standard database and use interfacing tools to manipulate objects. Oracle's technology thrust is on the Oracle Media Server for interactive services. This provides read-only access to multimedia for consumers. It accesses text and binary objects stored in other databases, including Oracle7, Oracle Text and Oracle Media Data Store. The Media Server adds a real-time video stream server to data from relational databases. It also supports system monitoring, system management, network monitoring and

billing systems. Oracle has also developed the Media Net to connect the various databases that make up a system.

Consumer services is not the only market for this technology. The ability to handle large files and real-time data can apply to many business applications.

### *Strengths*

- Strong installed base
- Has developed applications, such as Oracle Financials, on the basic database technology that can be converted to OO applications over time
- Over 40% of Oracle's revenues are for services.
- Oracle is likely to be very strong in video servers and related services because of the investment made in the Media Server.

### *Weaknesses*

- Not an OO architecture, hence considerable programming support has to be undertaken
- May announce products prematurely in an effort to gain market share

### *Outlook and Assessment*

Oracle is likely to be very successful in supporting many classes of objects, albeit not as efficiently as in some OO databases. The market presence of Oracle means it will continue to compete effectively in some applications against object databases. To expand its product line for applications for which OO databases are more convenient than a standard Oracle database, Oracle may consider acquiring an object database vendor as the market matures. By investing in the Media Server, Oracle positions itself to support massive databases.

## **24. ParcPlace**

### *Strategy*

A pioneer in the Smalltalk programming language, ParcPlace's mission is to sell object-oriented development environments for mainstream corporate computing. ParcPlace sells both directly

and indirectly through computer manufacturers, systems integrators and value-added resellers. In early 1994, the company had a successful initial public offering.

ParcPlace's VisualWorks creates applications that are portable across leading PC and UNIX platforms. VisualWorks runs across multiple platforms, using identical application code. For a VisualWorks application, a Smalltalk object engine is compiled and installed on each machine. ParcPlace's Smalltalk engines run on Windows, Windows NT, OS/2, UNIX and MacOS.

### *Strengths*

Several customers select VisualWorks over Powersoft's PowerBuilder or Gupta's SQL Windows because it is easier to move from high-level to low-level programming. PowerBuilder and SQL Windows may be adequate for adding visual user interfaces to databases, but they lack some of the lower level object support provided in Smalltalk by ParcPlace. Traditionally, Smalltalk programs have been perceived as slow. This is no longer the case, given more powerful desktop computers.

VisualWorks' product strengths are:

- Scalability from high-level to low-level programmers, from Macs to Windows to UNIX machines, from clients to servers, from small systems to large systems
- Maintainability
- Portability across PCs, workstations and servers
- Maturity of underlying class libraries
- High-quality design of VisualWorks' user interface

Strengths of ParcPlace's market approach are:

- Leveraged sales through systems integrators and OEMs
- Strong consulting and training services to educate customers and gain market acceptance
- High-quality partners such as Hewlett-Packard, Gemini Consulting, and Sequent

### *Weaknesses*

Future product developments need to provide:

- Greater support for programming teams
- Increased support for access to multiple databases
- Higher level applications frameworks

Risks in ParcPlace's market approach are:

- Increased competition from Powersoft as it moves its software to the Macintosh and other platforms
- Increased competition from well-funded database companies that acquire or build tools comparable to VisualWorks
- Microsoft's OLE 2.0, as it becomes more widely deployed across a variety of platforms, could encroach on HP's Distributed Smalltalk market.
- Lack of well-trained Smalltalk programmers. ParcPlace addresses this problem by making its code easy to learn and providing training classes.
- High cost of sales—direct sales are expensive to support. Currently, this can be covered by training and consulting revenues, but in the long term more efficient distribution will be required.

### *Outlook and Assessment*

ParcPlace needs to increase its partnering programs and grow by acquisitions and/or mergers. It needs to encourage more vertical market software vendors to adopt its tools. It needs to build on its relationships with database vendors. It may consider merging

with or acquiring an object-oriented database vendor. ParcPlace has a strong management team and can continue to grow, especially as Smalltalk and OO products become more widely accepted.

## 25. Persistence Software

### *Strategy*

Persistence is an emerging vendor that provides software for object-oriented transaction processing. Its tools map C++ code into Sybase, Oracle, Ingres and Informix relational databases. They also manage objects that are used to link applications to relational databases. Business and programming object models can be entered into Persistence and translated into formats understood by server databases. Persistence has been used by CBIS (Cincinnati Bell Information Systems) and Federal Express, and for factory automation.

### *Strengths*

- Handles large systems
- Traditionally used by UNIX programmers; recently moved to support Windows
- Databases or object models can be changed, even after Persistence has been installed.
- Strong reference sites

### *Weaknesses*

- Persistence offers an intermediate product and must partner with other vendors to provide a complete solution.
- Persistence needs more sales leverage through VARs and OEMs.

### *Outlook and Assessment*

Whereas many corporate developers will use COBOL or Smalltalk and not C++ to access relational databases, for those that do use C++ Persistence provides reliable database access. This could be a company to watch as it expands its object capabilities. A competitor to Persistence is Micram Object Technology, a

distributor for Objectivity/DB in Germany and provider of Classify/DB that links application development tools to databases.

## 26. POET Software

### *Strategy*

POET is a German company that has an OODBMS that is marketed on PCs with a starting price of \$499 for users and \$1,995 for developers. This low price has given POET the largest number of unit shipments of any OODBMS. Besides running on PCs, it also runs on NeXTSTEP, UNIX, OS/2 and Windows NT.

### *Strengths*

- Low price, high market penetration
- Strong marketing to software developers in technical publications
- Useful for storing C++ objects
- Strong technical support

### *Weaknesses*

- Not scalable to high-end systems
- Only one U.S. sales office

### *Outlook and Assessment*

This is a strong product with which to experiment with an OODBMS, as it has a low cost and is readily accessible.

## 27. Powersoft

### *Strategy*

At the heart of Powersoft's tools is a scalable object engine. PowerBuilder is sometimes considered an *object-based* system, rather than an OO system, because it is not as extensible as some of the Smalltalk-based tools. PowerBuilder also has a messaging-based language, a common object library manager and interfaces to other OO systems. The PowerBuilder application library provides a collection of objects, such as buttons, windows and scroll boxes. Powersoft's CODE (Client/Server Open Development Environment) supports standard interfaces to databases, networks and CASE tools.

### *Strategy*

Revenues for 1993 were \$51 million, up from \$21 million in 1992. Powersoft's remarkable growth can be attributed to:

- High-quality interface appearance—Powersoft has developed a tool that creates attractive-looking screens. The screen textures, buttons and scroll boxes are visually appealing.
- Desktop mindshare—Powersoft has succeeded—along with vendors like Gupta—in gaining mindshare among corporate developers that need a Windows interface to existing databases.
- Responsiveness and high-quality support—Powersoft ships a CD ROM of technical support questions and answers, as well as high-quality support materials, with its products.
- Strong VAR and reseller program—Powersoft has over 60 training partners, greatly augmenting its internal training staff.
- Scalable pricing—PowerBuilder Desktop lists at \$695, but is discounted to \$249. The PowerBuilder Developer Toolkit lists for \$395. This enables the smallest developer to create applications using PowerBuilder.
- Modular product line—Powersoft has broken its product line into enterprise and client tools. Interface products are priced separately; for example, the ODBC interface retails for \$695. It also provides interfaces for pen computers, Lotus Notes, Netware and other development tools.

- Powersoft recently acquired the WATCOM database, thereby enhancing its product line to include both client and server software.

### *Weaknesses*

- Macintosh and UNIX platform support is later than Windows support. This has given UniFace and Blyth Software the opportunity to gain seats in the Macintosh market.
- Lack of robustness—PowerBuilder sometimes crashes in client/server applications. This is largely because of the weakness of Windows as a client operating system.
- Lack of enterprise support—Depending on how an organization intends to support thousands of users, PowerBuilder Enterprise may not support the range of platforms or interfaces required. In addition, security features such as user authentication may need to be added for some organizations.
- Powersoft's software needs to scale better from users to developers. To address the user programmer, Powersoft has a forms-based user interface creator, PowerMaker. PowerBuilder Desktop's interface user interface could be made simpler, with more default options and programming options available at a second level. This is analogous to Microsoft Word, which has the option of short or long menus for novice or expert users. This would make the tool more efficient, as users would be able to create their own screens and pass them to a programmer for incorporation into a more complex system using the same software.

### *Outlook and Assessment*

Powersoft already supports objects to the extent required by most database users and corporate programmers. For the majority of applications, Powersoft provides a range of tools that can be used to create user interfaces and reports.

Powersoft can be expected to support more platforms and provide greater performance for enterprise applications. It should benefit from Microsoft's database thrust into the database market that will generate awareness for WATCOM. PowerBuilder's support



of Microsoft's ODBC standard for database access should continue to strengthen its presence for departmental LANs.

## **28. Raima**

### *Strategy*

Raima is a small vendor of an OO database for C++ programmers that can be incorporated into C++ applications to provide object persistence. This means that the state of the application can be preserved in the event of most programming errors and crashes.

### *Strengths*

- Highly regarded by C++ developers
- Focused marketing; applications software developers are key customers

### *Weaknesses*

- Little visibility

### *Outlook and Assessment*

Raima is branching out into the ODBMS commercial market. It needs stronger marketing outside the technical community and strong alliances with software publishers.

## **29. Sapiens**

### *Strategy*

Sapiens provides Ideo, a development tool that integrates databases and designs user interfaces. The software is built on an OO engine that optimizes interfaces to SQL for different databases.

### *Strengths*

- Cross-platform client support on Macintosh, Windows and various UNIX platforms; server support on Digital, IBM, Sun and HP platforms running Oracle, Informix, Ingres, Rdb, Sybase or Ideo's RDBMS
- Financially sound—\$70 million in cash (first quarter 1994); debt free.
- Strong support and services

*Weaknesses*

- Distribution—Introductory system needs to be more widely promoted.

*Outlook and Assessment*

Sapiens needs to increase its visibility to systems integrators, value-added resellers and developers. Its products are strong, particularly in Europe.

**30. Servio***Strategy*

Servio (formerly Servio Logic) develops and markets the GemStone OODBMS and GeODE, a development tool. GeODE is generally marketed as a user interface to GemStone. Servio's strategy is to:

- Support more platforms, such as MacOS and Windows, having concentrated on the UNIX market
- Solve large database problems that require computation in the server
- Integrate legacy databases across WANs

*Strengths*

- Integration of multiple databases to create federated databases. Best for integrating both applications logic and data, rather than data only.
- Strong support for Smalltalk
- Replication of OODBMS

*Weaknesses*

- GeODE is not widely licensed separately from GemStone and may be under pressure from VisualWorks and Object Studio, long term.

*Outlook and Assessment*

Servio has been able to capitalize on its strengths in Smalltalk Technology to support networks with over 1,000 users. By concentrating on large distributed systems and partnering with

systems integrators in vertical markets, Servio can develop solutions for specific applications.

### 31. SunSoft

#### *Strategy*

SunSoft is the division of Sun Microsystems responsible for the Solaris operating system. It is working with NeXT to create OpenStep, NeXT's software running on Solaris. Both NeXT and Sun are working with XOpen to make OpenStep a standard.

#### *Strengths*

- The integration is going well, according to Sun engineers. Bud Tribble, a key SunSoft manager for the project, was VP of Engineering at NeXT, so there is considerable cross-fertilization of ideas and expertise between NeXT and Sun.
- Sun's Workshop for C++, its application development environment for C programmers, has been well received by the UNIX community. By leveraging its relationships with developers, Sun may be able to provide them with NeXT's development tools as an additional product.

#### *Weaknesses*

- Solaris has not been licensed by Sun as widely as anticipated. Sun may have difficulties expanding the market for Solaris on Intel platforms, given Microsoft's improvements to the operating system.

#### *Outlook and Assessment*

Some UNIX vendors are skeptical about the ability of OpenStep to be a truly open standard, as it is controlled by NeXT. Hardware vendors must individually contract with NeXT to obtain access to the NeXTSTEP source code. In the UNIX developer's mind, source code access is often a key criterion for being open. NeXT and Sun have published the first OpenStep definitions and they are APIs, which some developers believe are not much more than the documentation found in NeXTSTEP manuals. This is in contrast to the X.11 Windowing system and Motif, the current UNIX user interface, where the source code is available for licensing.

The converse is that by not licensing the source code freely, NeXTSTEP retains its consistency. Also, by keeping the price of licensing the NeXT source code relatively high (Sun paid \$10 million to be able to jointly develop it), NeXT has a viable business model that enables it to invest in new releases.

Sun has had a history of changing the user interface. When the majority of UNIX vendors were adopting X-Windows and Motif, Sun chose to first develop NEWS, a Postscript-based windowing system. Then Sun developed OpenLook with AT&T instead of Motif on top of X-Windows. In both cases, a feature-by-feature evaluation of NEWS and OpenLook would have placed them ahead of the competition. Neither of these two user interfaces was widely accepted. So it remains to be seen whether NeXT and Sun together can make OpenStep a desktop standard. OpenStep is a simpler and more powerful user interface than either NEWS or OpenLook; in addition, it provides the foundation for rapid development of client/server applications.

Sun's best opportunity for success with OpenStep is to leverage its sales to developers. Many organizations use Sun machines for C++ development. It is unlikely that established C++ programmers will migrate quickly to OpenStep, as they already have an investment in existing applications that may be difficult to modify. However, for new programming teams and for Sun's current accounts that need to get a product out quickly, Sun may be able to provide OpenStep as a solution.

Until UNIX vendors can provide a single-button mouse user interface and a cleaner user interface, UNIX will not be able to displace Macintoshes and Windows machines in mass-market client/server applications. INPUT believes that NeXT and Sun will see success for OpenStep in niches, but that as a mainstream UNIX platform, it will not see widespread acceptance until IBM accepts it on AIX.

## 32. Sybase

### *Strategy*

Sybase's strategy is to integrate data from different databases. Sybase is committed to supporting multimedia applications with its *Momentum* OO software, acquired from Gain. It uses

Objectivity's OO database to create animated user interfaces to traditional SQL databases.

*Momentum* addresses three markets: information delivery, department-level database applications and enterprise-level applications. Gain *Momentum* is being used for information delivery. It is ideal for kiosk applications and was used in the 1994 World Cup. Enterprise *Momentum* is for large-scale, multidepartment development and generates both client and server parts of an application. Build *Momentum* is a GUI development tool for production applications.

#### *Strengths*

- High-quality connections to IBM mainframe data, in particular VSAM files
- Leading-edge transaction processing technology
- U.S. systems software revenues are not much lower than Oracle's for database software.

#### *Weaknesses*

- Sybase was licensing its SQLServer to Microsoft. Now Microsoft and Sybase want to compete. This could make Sybase vulnerable. Alternatively, Microsoft's publicity could make Sybase more successful in low-end products.
- System10 is not easy to learn, and has many APIs.
- Sybase does not have applications products, as Oracle does.

### **33. Taligent**

#### *Strategy*

Founded in 1992, Taligent is focusing on developing application frameworks that form software components for client/server development. Its goal is to realize the promise of object technology. In January 1994, HP purchased 15% of Taligent, joining IBM and Apple as investors.

The frameworks are oriented toward the desktop and based on a "people, places and things" metaphor. The aim is to provide programmers with tools that will give them considerable productivity improvements. Its initial Partners Early Experience

Kit (PEEK) was officially released to 100 developers in May 1994. This included a pre-beta version of the TalAE (Taligent Applications Environment).

Taligent is targeting OS/2, AIX, HP-UX and future versions of the MacOS. However, given Taligent's aim to be cross-platform, one can expect it to be deployed on Windows platforms eventually, if it is to be successful.

### *Strengths*

- The underlying common framework aims to enable developers to integrate application code better, develop faster, reduce errors, re-use code and share common code elements—necessary features for networked applications.
- Software will be released in stages.
- 100 development organizations have been selected initially; the majority are software development firms, some are user organizations and some are universities.
- Backing of IBM, HP and Apple; note, however, that all of these vendors have other platforms
- Taligent's goal is to be cross-platform and support OS/2, Windows NT, MacOS, and UNIX.

### *Weaknesses*

- Large development team—Over 300 programmers working on a new product are likely to make it difficult to coordinate development efforts.
- Slow to roll out product—Taligent may be better off releasing modules gradually and attempting less comprehensive projects.
- Lack of immediate acceptance by Apple—Although Apple claims to be behind IBM in releasing Taligent code because it is working on its PowerPC port of MacOS System 7.5, it would not be surprising if Apple chose to continue with its own developments and have only a minor commitment to Taligent.
- Apple is not rushing to endorse Taligent's technology.

### *Outlook and assessment*

Taligent is not IBM's only strategy. IBM has stated that its future operating systems will have many "personalities." Taligent's success will depend on several factors:

- Acceptance by programmers
- Development of applications that are superior to existing systems in terms of time to develop, cost to maintain and functionality
- Ability to create new markets

UNIX developers typically use a suite of tools that are run under a common workbench that integrates compilers, debuggers, editors and optimizers in multiple windows. The UNIX programming environment is made up of various small modules. Taligent is addressing the fragmented UNIX tools market by integrating its libraries into a common framework. Whereas a comprehensive tools strategy is appropriate for corporate IS organizations and system integrators, it is not clear that the packaged software vendors will embrace Taligent's environment. This is because unless Taligent runs across all UNIX platforms, it will burden the developer who has to compile code separately for each platform.

The success of Taligent will depend not on its technology, but on the support it can gain from major developers and the support that it gets from IBM. At present, its outlook appears very risky. It has so many frameworks that some are likely to succeed. To be successful, Taligent has to break new ground and simplify complex integration tasks. The messaging frameworks may succeed. However, there is strong competition from messaging vendors Lotus and Microsoft, with Notes/FX and Enterprise Messaging, respectively. Success for the Taligent vision of integrated applications built on a common platform is much less likely.

## **34. Trinzic**

### *Strategy*

Trinzic was formed by the merger of Aion and AICorp (formerly Artificial Intelligence), both developers of expert system development tools. Since then, Trinzic has positioned itself in the

client/server development tools market. Its main GUI development tool is ObjectPro. ObjectPro compiles into C code and is designed for professional programmers. It works with AionDS that combines business rules with GUI design, interfaces to relational databases and support for legacy systems. Trinzic believes that the rules-based approach enables customers to develop more sophisticated business logic with less code than in PowerBuilder or SQL Windows.

### *Strengths*

- ObjectPro supports Oracle and Sybase through native interfaces, Ingres, Informix, SQLBase, DB2/2, Allbase, Access, dBase, FoxPro and other ODBC-compatible databases. Two other products for client/server interfaces to relational databases InfoHub and InfoPump are being marketed by Sybase. This OEM strategy has helped Trinzic successfully change its position from artificial intelligence vendor to client/server vendor.
- ObjectPro can integrate with legacy code, either bringing COBOL into ObjectPro or adding business rules to COBOL programs.
- Trinzic has excellent partners—IBM, Sybase, Oracle, Sun, and Digital—however, many of these relationships need to be built on to leverage Aion.
- Trinzic's business rules language is simpler than SQL and many other 4GLs.
- Trinzic provides integration between objects, GUI development tools and rules.
- ObjectPro interfaces to CASE tools Texas Instrument's IEF and KnowledgeWare's ADW.
- Trinzic offers both interpreted (for fast debugging) and compiled (for faster run time performance) development environments.

### *Weaknesses*

- Though Trinzic is known for its database interface technologies, it may be hard for it to gain visibility for its visual development tools.



### *Outlook and Assessment*

Trinzic has gained a strong reputation for its InfoHub and InfoPump products that are used by Sybase to connect to mainframe data. Trinzic is late to the market with ObjectPro. Trinzic needs to focus on its connectivity products and use ObjectPro in niche applications to succeed.

## **35. UniSQL**

### *Strategy*

UniSQL aims to bridge the interface between OO languages and C++. Its focus is on integrating databases, both on servers and on the desktop. Its products are:

- UniSQL/X—announced in 1992, a hybrid relational and OO database
- UniSQL/M—a heterogeneous database system that maps data from both relational and OO databases into a common logical database
- UniSQL/4GE—an application development environment
- UniSQL C++ interface—allows C++ programmers to map C++ objects into relational databases

### *Strengths*

- Distribution agreement with Cincom
- Scalable pricing, which starts at \$3,995 for a single user version of UniSQL on Digital's OSF
- Well-respected technical management—Dr. Won Kim, President, is from MCC, where he undertook research in object databases.
- Can retrieve and store objects using standard SQL commands. The database combines navigational access of OO databases with associative access of relational databases, and also supports Microsoft's ODBC.
- Objects can be compiled in any programming language.

- Supports standards such as those supported by ODMG and SQL
- User interface with VisualWorks

#### *Weaknesses*

- Small, emerging vendor
- Needs more VARs and indirect distribution
- UniSQL needs more presence in the Windows LAN market; currently the company is focused on UNIX platforms.

#### *Outlook and Assessment*

UniSQL has well-respected management. It makes the benefits of OO databases accessible to programmers familiar with relational databases. It will continue to provide a migration strategy for users from relational to OO systems. It also provides developers of C++ applications with access to relational databases for storage. This should be useful for LAN application developers that may not have required database support in single-user versions of their software, but in networked applications may require the features of a relational database.

## C

---

### Typical Support Strategies

Exhibit VIII-4 summarizes the support strategies of a few vendors.

The most successful OO platform vendors have extensive training support. Companies interviewed typically find that training is more successful when training in object-oriented technology precedes training with a specific tool. Consulting in object-oriented technology provides an additional opportunity for vendors.

Exhibit VIII-4

## Support Strategies of Select Vendors

Vendor	Education and Training	Technical Support
Digitalk	Regional seminars, training affiliates, Digitalk training facilities at five U.S. sites. Numerous public seminars.	Corporate Developer's Support Package, mentoring, consulting on both managerial and technical topics, custom engineering. CompuServe forum and E-mail support.
KnowledgeWare	Staff of over 90 provides training, a \$12M business. Plans are to increase training and support.	Three maintenance plans for ObjectView: Corporate, 900-Hotline and KnowledgeWIRE (by fax). 30-day money-back guarantee, 90 days free support.
NeXT	Has extensive training courses, including courses that cover staffing requirements for NeXTSTEP development.	Object Experts – \$25,000 a month on-site support.  Electronic mail to nextanswers@next.com, CompuServe forum, ftp site.
Powersoft	Trained almost 20,000 developers in 1993. Has 8 Powersoft training centers and over 60 training partners; many are emerging regional VARs.  Initiated program with leading educational institutions for corporate developers—Strategic Training and Retraining Program.	CD ROM supplied with the PowerBuilder Desktop has over 40,000 entries and describes problems and their resolution.  CompuServe, BBS, FAXBACK, consulting and hotline support.
Sapiens	Provides training and consulting services.	6 a.m. to 5 p.m. Pacific Time by phone, also E-mail.
Sybase	Strategic, operational and technical consulting groups. Acquired OASIS PLC in 1994 to provide re-engineering consulting.	24-hr., 7-day technical support. Customer Technology Institute addresses customer issues; User Group meetings have 3,000-5,000 users. Works with design partners to design new applications.

Source: INPUT

**D****Distribution Channel Analysis**

---

This section looks at the distribution channel strategies of select vendors. Exhibit VIII-5 shows the strategies of vendors of OO environments. The first column provides the vendor's name. The second column lists OEMs or partners that may resell products or invest in the company. OEMs and partners are hardware manufacturers or software vendors that resell, usually under their own label, products from vendors. VARs (value-added resellers) are small systems integrators that take software and customize it or resell it with equipment. They are shown together with third-party software developers and systems integrators. The final column describes those that usually buy finished products—distributors, users and retailers. In practice, the lines are blurred between the categories.

The key to success as an OO environment vendor is strong OEM relationships. NeXT has strong OEMs, but these OEMs have alternative platforms based on their existing products that could run OO applications written in Smalltalk. NeXT would be vulnerable, were it not for very large customers in its key vertical markets.

## Exhibit VIII-5

## Channel Strategies of Leading OO Environment Vendors

Vendor	OEMs and Partners	VARs, Systems Integrators and Software Developers	Distributors, Retailers and Users
IBM		<p>Partnering with Apple as an investor in Taligent and cooperating with Apple on PowerOpen and OpenDoc.</p> <p>Development conference on OO attracted over 400 participants.</p>	<p>Users: a Swiss railroad, American Airlines, GE Medical, Boeing, Alumax, UK Civil Aviation Authority, Siemens, Westinghouse</p> <p>Commercial OO development underway at 15 locations.</p>
NeXT	<p>Sun—putting OpenStep on Solaris.</p> <p>Hewlett-Packard—resells NeXTSTEP both on PCs and workstations.</p> <p>Digital—sees opportunity for NeXTSTEP on both PCs and</p> <p>Canon—manufacturing black PC to support NeXTSTEP</p> <p>PC Vendors—NEC is shipping NeXTSTEP on its machines</p>	<p>Partnerships with more than 60 integrators in North America, Europe and Japan. Has more than 500 applications on NeXTSTEP.</p> <p>SHL Systemhouse</p> <p>Marble—a company specializing in network protocols and integration</p> <p>Martin Marietta Information Systems &amp; Technologies</p> <p>Teknekron Software Systems</p>	<p>Failed at selling original hardware in retail channels.</p> <p>Focus is on financial services, health care, government.</p> <p>Chrysler Financial, Swiss Bank, Pencom, McCaw Cellular, MCI, AT&amp;T, WilTel, Rogers CANTEL, NTT (Japan), Helsinki Telephone, LA Cellular, William Morris Agency, NationsBanc-CRT, Phibro Energy, Mount Clemens General Hospital</p>
Taligent	<p>Apple, IBM, and HP are all investors; IBM is expected to offer the product first on its PowerOpen platform.</p>	<p>Initial release was to 100 developers. HBO, a health services vendor, was a customer. Many are small entrepreneurial firms. Some are corporate developers and others are in universities.</p>	

Source: INPUT

Exhibit VIII-6 shows channel strategies of visual development tool vendors.

Exhibit VIII-6

### Channel Strategies of Visual Development Tool Vendors

Vendor	OEMs	VARs, Systems Integrators and Software Developers	Distributors, Retailers and Users
Digitalk		Many VARs and small developers. Major systems integrators have also incorporated Smalltalk/V in their tools.	Strongest retail program of any Smalltalk vendor. 125,000 users worldwide.
Forté	Digital	Data General, Digital, IBM, and Sequent are all engineering and marketing partners.	Will mainly use direct sales, but will also support VARs and OEMs. Global 5000 organizations are the key potential customers.
Gupta	KnowledgeWare is selling Gupta's SQLBase engine.	C/S Business Partner program supports developers, consultants, and systems integrators. Provides lead programs, seminars, and marketing support.	
KnowledgeWare	None, but technology partnerships with HP, IBM, Informix, Ingres, Lotus, Microsoft, Netwise, Novell, Oracle, Sun, Sybase and Tandem.	140 system integrators in KNOVA Client/Server Alliance Program. Expanding.  Over 40 Enhancement Partners, established software and hardware vendors	Has shipped to over 5,000 companies in 50 countries. 10 direct sales offices
Neuron Data		Over 80 VARs and ISVs, including AMS, Andersen Consulting, Bechtel, Digital, EDS, Harte-Hanks, IBM, Moody's Nasdaq, Sony, and Sterling Software	11 direct sales offices, including the U.K., France and Japan
Open Data Corporation	None, although field relations with IBM and Sybase	Application vendors, CASE and repository vendors, third-party software relationships: IBM, Sybase, Oracle, Microsoft; systems integrators: IBM, Andersen Consulting, Digital	Selling direct to Fortune 1000 in insurance, utilities, banking & finance, and manufacturing

Exhibit VIII-6 (Continued)

Vendor	OEMs	VARs, Systems Integrators and Software Developers	Distributors, Retailers and Users
Powersoft	None, although it has relationships with major hardware manufacturers like Compaq and Dell for support	Over 80 VARs, Dec.1993	Has shipped to over 3,500 companies. Uses retail chains and programmers' tools catalogs.
Sapiens	Exclusive marketing agreement for Sapiens and SWS with IBM in the U.S.	Supports CASE tools from KnowledgeWare and Bachman	Overseas distributors, mainly direct sales in the U.S. Over 450 professionals worldwide; Latin America, South Africa, Israel, Poland, and Korea are among 29 offices around the world.
Sybase	Formerly Microsoft for SQL Server	Over 600 applications developed by ISVs. Has programs for ISVs, VARs and SIs. Aims for 30% of sales through indirect channels by 1995.	Direct sales is the main channel—47 North American offices, 29 regional user groups, 21 in North America. Europe, Hong Kong, Japan and Mexico have Sybase offices; in other areas sales are via distributors. 13,700 customer sites worldwide.  Gain Momentum has 75 customers.
Trinzic	Sybase for InfoPump and InfoHub	VAR partnership program	Over 1,200 companies as customers; overseas offices in Europe, the Pacific Rim, and South America

Source: INPUT

Exhibit VIII-7 provides channel strategies of object database vendors.

Exhibit VIII-7

### Channel Strategies of Object Database Vendors

Vendor	OEMs and Partners	VARs, Systems Integrators and Software Developers	Distributors, Retailers and Users
Object Design	<p>KnowledgeWare for a business process re-engineering tool. Cadence for engineering.</p> <p>IBM markets ObjectStore. HP has rights to ObjectStore for its distributed object management facility (DOMF).</p> <p>AT&amp;T is an investor.</p>	<p>HP - SoftBench integration, Electronic Books for publishing software.</p>	<p>Ameritech, Avanti Systems, Boeing, Chemical Bank, ChemShare, Domestic Automation, Ericsson Telecom, Ford, Honeywell, IBM, Martin Marietta, NEC, NYNEX, Price Waterhouse, Texas Instruments, Xerox</p>
Objectivity	<p>Forté, Sybase, Frame (an investor evaluating Objectivity for document management), Digital</p>	<p>Micram (Germany), Osaka Gas Information System Research Institute (Japan)</p> <p>Persistence, to connect to RDBMSs; HP to integrate with SoftBench, CenterLine, Microsoft, and Dharma Systems</p>	<p>Over 50,000 users: Bell Northern Research (joint development), Bell Sygma, BT, DSC, Hughes Network Systems, Mercury, MTEL, Siemens, Boeing, Cimplex, Citibank, ICL, Kinetsu, Mead Data, Aerospace Corp.</p>
POET	Associated Press	EDS, Andersen Consulting, CSC, Booz Allen, and SHL	4,000+ installations worldwide. Human Genome Project, Health Trak, Siemens, AT&T, MCI, US West, Intel, Motorola, Mercedes Benz, Chevron, Helix Systems. Government, banks, research institutions
UniSQL	Cincom	Third-party relationships with HP, IBM, Sybase, Oracle, Sun	POSC
Versant	<p>IBM for AIX CASE repository</p> <p>Wellfleet</p>	Third-party relationships with CenterLine, ParcPlace, Sequent, SunSoft, and Tandem	Sells mainly directly

Source: INPUT



**E****Standards Organizations**

---

Standards bodies and associations for OO development are:

- **OMG—the Object Management Group**—is the main group for object interchange. It has about 400 members. Formed in May 1989, the objectives of OMG are to foster the growth of OO technology and influence its direction in the following five areas:
  - Overall architecture, reference model and terms—industrywide consensus on an Object Management Architecture, definition of terms and a common model for objects and their attributes, relationships and methods.
  - Applications Programming Interfaces (APIs) for objects and applications—object management facilities for a common API across DOS, OS/2 and UNIX, including distribution, class libraries, document content architecture and methodology
  - Distributed object management—applications and APIs for object distribution across heterogeneous networks, RPCs and operating systems
  - Interfaces to OO databases—pragmatic interfaces and abstractions to existing databases management systems and OO databases
  - Common services—specifications for interfaces and common services such as security authentication and system management

- **ODMG—the Object Database Management Group**—is standardizing interfaces to object databases. ODMG-93 is the main interface standard. It defines a language, OQL—object query language—analogue to SQL for relational databases. It also defines ODL—object definition language—which maps to the OMG's IDL as well as C++ and Smalltalk interfaces. Voting members pay \$8,000 per year plus an initiation fee of \$2,000 and commit 20% of a technical expert's time to the group. Reviewer members pay \$4,000 per year plus an initiation fee of \$1,000 and commit 10% of a person's time to the project. The group's focus for late 1994 and 1995 is to get members to implement the ODMG-93 standard and to improve the interfaces to C++.
- **ASSET—Asset Source for Software Engineering Technology**—is sponsored by the Advanced Research Products Agency (ARPA) organized under the STARS program. ARPA tasked Loral Federal Systems (formerly IBM Federal Systems) and SAIC to establish the ASSET Reuse Library to provide a distributed support system for software reuse within the DoD and to help foster a software reuse industry within the United States.

ASSET's initial and current focus is on software development tools, reusable components, and documents on software development methods. ASSET is participating in interoperation with other reuse libraries, such as CARDS and DSRS. To achieve these goals, ASSET operates the ASSET Reuse Library and Newsgroup services. ASSET is populating its library with quality reusable software components, which can be distributed to its subscribers. The library specializes in software lifecycle artifacts, and in documents written specifically to promote software reuse and development. An ASSET account allows users to perform customized searching, browsing, extracting, and downloading of the components contained in the ASSET Reuse Library. The ASSET Reuse Library contains both public domain assets and assets with limited distribution, such as those for 'Government Agencies and Contractors Only.'

**F****Alliances**

Mergers and acquisitions are expected to increase in the client/server systems software market. Database vendors are aligning with tool vendors. OO database vendors are aligning with traditional database vendors. Exhibit VIII-8 below analyzes recently announced relationships.

Exhibit VIII-8

**Alliances**

Vendors	Description	Assessment
ParcPlace and Objectivity	July 1994 ParcPlace and Objectivity will support joint marketing efforts.	Objectivity needs ParcPlace's software to simplify access to its database more than ParcPlace needs Objectivity. ParcPlace already has interfaces to ODBMSs. Both companies should be able to leverage sales and marketing. Object Design may have been a better partner for ParcPlace as it has the number-one position in mindshare among ODBMS vendors. This could be a prelude to a merger—if not at least part of the trend for visual tools vendors to acquire or be acquired by database vendors.
Taligent, HP, IBM, Apple	Feb. 1994 HP joins IBM and Apple in investing in Taligent.	If Taligent's environment is successful, it gives HP the opportunity to compete with IBM. Taligent gets an infusion of capital, which it must need, given its over 300 employees and only early developers.

Source: INPUT

(Blank)



# Recommendations and Conclusions

This chapter gives INPUT's recommendations and conclusions.

## A

---

### Recommendations

#### 1. Recommendations for Users and Developers

Users need to consider the trade-offs between having a robust client environment that provides them with a competitive edge and supporting industry standards.

Using cross-platform tools on UNIX or OS/2 is the safest strategy for client application developments that need to be robust and support multiple networks simultaneously. Tools should be selected that also support the MacOS and Windows so that, as these environments become more reliable, client software can be ported to more widely accepted platforms. For many client applications, the installed base will dictate the use of Windows.

Factors that affect the choice of tool will be based on how the application is to be programmed. Some organizations will want to plan first, then code; others will want to code, then plan. Most will need to develop organized views of business objects as systems evolve. For others, a prototype may be created from screens and then re-engineered to develop a complete system. Design and analysis tools will be more important to enterprise developers than to small workgroups. Depending on the business logic needs, tools that can incorporate other applications may be needed.

Using intermediate databases to link SQL-based relational databases and OO development tools is a key strategy for many



revolutionize business to the same extent. Beyond training, technical support services and consulting, new services that may be based on object technology include:

- Multimedia services
- Consumer messaging
- Network and systems management services
- Component software rental or licensing

The pricing of services based on objects is an area for debate. In some services, advertisers, rather than users, may be the prime source of revenue.

## B

---

### Conclusions

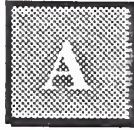
OO platforms are a major force that affects the ability of businesses to compete. Companies that do not embrace efficient OO designs will not be able to keep up with those that do.

OO development tools are likely to undergo a shakeout in 1995-1997. For platforms, this shakeout will come later, in the 1996-1999 timeframe. Object databases are likely to show significant growth potential in the next five years. Meanwhile, the major companies like Microsoft, Oracle, Sybase and Computer Associates will continue to acquire technology companies. Major database companies can be expected to acquire tool and OO database companies.

The market will fragment further. Vertical market applications will differentiate tools. Also, the look and feel of an application will become more customized and vendors will be able to differentiate on graphics and artistic design.

(Blank)





## Definitions

This appendix provides definitions of vocabulary used in the report that is not in INPUT's *Definition of Terms*.

- Agent* An agent is a set of instructions that can carry out tasks automatically. It is usually written in a high-level language script and may run across a network to send messages or find information.
- Applets* Either small applications or large objects that can be embedded in an application. A program to draw charts that can be shared by applications is an applet.
- Business Objects* System components that can be modeled at a higher level than the programming code. Typically, these objects are items like "order," "address," "person" and "workgroup." They are diagrammed to show how they interrelate when building the system.
- Business Logic* This is the logic that is written in computer systems. Many programs have logic of the form: *If A Is True, Then Do B*. This may be written in a 3GL or 4GL. It may also be represented by diagrams using software tools.

<i>Classes</i>	The general term for nested items in an OO program that represent the structure of the program. They are usually represented in a "class hierarchy." An example is the class "forms." It may contain subclasses "purchase orders," "expense vouchers" and "time sheets." It could have a parent class to which it belongs, "documents."
<i>Component</i>	Component refers to a software component, a piece of software with documented interfaces that a programmer can use to build an application.
<i>Development Environment</i>	This is the software needed to build an application. It may include a visual editor, a forms designer, a report writer, a compiler, an interpreter, a debugger or a source code control system that enables programmers to share coding tasks.
<i>Development Tools</i>	Short for "application development tools."
<i>Distributed System</i>	A system that runs across multiple computers.
<i>Encapsulation</i>	An object can be defined so that its external interface is well defined and methods can act on it without knowing the object's internal properties. It is the same principle as "data hiding."
<i>Enterprise Objects</i>	Another term for business objects when they are applied to the enterprise.
<i>Framework</i>	A specification or implementation of software that can be used to build an application. It may consist of classes and methods. Motif and the Common Object Request Broker Architecture (CORBA) are examples of frameworks.

<i>GUI</i>	Graphical User Interface—a windowing system like Microsoft Windows or X-Windows with Motif that displays graphical objects on a display.
<i>Inheritance</i>	A subclass has the same properties as the class from which it is derived.
<i>MacOS</i>	The operating system for the Apple Macintosh.
<i>Messaging</i>	A general term that describes communication that stores and forwards information. It may also support queues of objects waiting for an event in a network. An example of messaging software is electronic mail or software that supports on-line information services.
<i>Messaging Framework</i>	Software that can be used to create an application that uses messaging.
<i>Methods</i>	In OO programming they can be thought of as the "actions." They represent commands like "print," "get," "select" and "write."
<i>Microkernel</i>	The software that runs at the heart of an operating system. Although it is called a microkernel, it is not necessarily very small.
<i>Modularity</i>	The ability to separate a software program into parts or components.
<i>Object</i>	Actual implementations of classes. For example, "Purchase Order 909" is an object in the class "purchase orders."

<i>Object-based</i>	Although programs written using Windows or C++ have many OO attributes, they may not be modifiable once they have been compiled. These programs are typically called object-based when they contain objects like "buttons," "scroll bars," "windows" and "fonts." PowerBuilder and SQL Windows are considered object-based.
<i>Object-oriented (OO)</i>	Definitions vary, but true OO software exhibits attributes found in Objective C or Smalltalk programming languages, such as inheritance, persistence, encapsulation, polymorphism and run-time binding.
<i>Object-relational</i>	Used to describe databases that support features of a relational database like tables, relations and the SQL query language, but can also support objects.
<i>Objectware</i>	Software products built from objects.
<i>ODBMS</i>	Object database management system—includes ORDBMSs and ODBMSs.
<i>OODBMS</i>	Object-oriented database management system.
<i>Operating Environment</i>	Modern term for operating system plus its application development tools.
<i>ORDBMS</i>	Object-relational DBMS (see object-relational).
<i>OS</i>	Operating system.
<i>Packages</i>	Software applications built from components.
<i>PDA</i>	Personal digital assistant—a handheld personal information system and organizer.

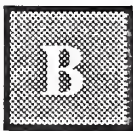
<i>Persistence</i>	If the system crashes, the state of an object can be recovered.
<i>Platform</i>	This is the software or hardware that an application program runs on.
<i>Polymorphism</i>	The same method can behave differently on different objects. For example, using the command "print" on a fax machine and a printer has two different meanings. In the first case it sends a fax. In the second case it prints a document.
<i>Programming Objects</i>	These are objects used by C++ and Smalltalk programmers. They may look like: COtherObject, CMyObject, etc.
<i>Run-time Binding</i>	This means that when a program is run the components are linked together. In traditional compiled programs, the programs are linked when the application is created, not when the user runs it. The advantage of run-time binding is that modifications can be made at the last minute or when the user is running the code.
<i>Suites</i>	Sets of applications or packages. Office suites typically consist of a word processor, a spreadsheet, and a database or electronic mail package.
<i>True OO Language</i>	Smalltalk and Objective C are considered true object-oriented languages because they allow components to be added or changed when the application runs, as opposed to when it is being created by the programmer.

*Visual Development Tool*

An application development tool that can be used to create user interfaces. It may also create other applications.

*Windows*

Used in this report to refer to Microsoft's Windows, if it starts with a capital letter. If it starts with a small letter, it may refer to any software that controls the windows on a computer screen. A window may also be the window seen on a computer screen.



## Vendor Names and Addresses

This appendix provides names and addresses of vendors and organizations mentioned in the report.

### A

#### Vendors and Organizations

Exhibit B-1

#### Names and Addresses of Vendors

Company	Notes
<p>ADB 12-14 rue du Fort de Saint-Cyr Montigny-le-Bretonneux 78182 Saint-Quentin en Yvelines Cedex France Tel: 011-33-1-30-14-54-30 Fax: 011-33-1-30-14-54-40</p> <p>ADB Inc. 238 Broadway Cambridge, MA 02139</p> <p>Tel: 617-354-4220 Fax: 617-547-5420 info@adb.com</p>	<p>M.A.T.I.S.S.E. database that works with relational databases and integrates OO CASE tools from GE and IDE C++ or SQL</p>
<p>Andersen Consulting 69 West Washington Street Chicago, IL 60602 Tel: 312-580-0069</p>	<p>Strong commitment to objects. Uses Smalltalk and other tools for application portability and ease of programming.</p>

## Exhibit B-1 (cont'd)

Company	Notes
<p>Apple Computer 20525 Mariani Avenue Cupertino, CA 95014 Tel: 408-996-1010 Fax: 408-996-0275</p>	<p>Potential OO environment vendor.</p> <p>Expect Apple to become a significant OO player over the next five years, because of initiatives with OpenDoc. Distributed objects and multimedia support Apple products will be used in innovative C/S systems, particularly in desktop document systems and mobile communicator (Newton) client/client applications.</p>
<p>AT&amp;T Global Information Systems (was NCR) 1700 S. Patterson Boulevard Dayton, OH 45479 Tel: 513-445-5000 Fax: 513-445-4184</p>	<p>Developer of OO tools.</p> <p>Provides distributed object foundation class libraries and CASE tools for developing communications services, based on C++.</p>
<p>Autodesk 2320 Marinship Way Sausalito, CA 94965 Tel: 415-332-2344 Fax: 415-331-8093</p>	<p>Application developer that uses OO software.</p> <p>Autodesk's main product is its AutoCAD engineering drawing package. This uses CLOS, an object-oriented form of LISP.</p>
<p>Borland 100 Borland Way Scotts Valley, CA 95066-3249 Tel: 408-431-1000 Fax: 408-439-9262</p>	<p>Vendor of visual development tools.</p> <p>Borland has a strategy to provide scalable systems using dBase for Windows and Interbase as its key components. These it will support with OO tools.</p>
<p>Component Integration Laboratories 688 Fourth Avenue San Francisco, CA 94118 Tel: 415-750-8352 Fax: 415-615-7908</p>	<p>Developers of OpenDoc, a cross-platform technology for integrating document and presentation components such as tables, charts, video, sound, text and pictures.</p>
<p>Digital Equipment Corporation 110 Spitbrook Road Nashua, NH 03062 Tel: 603-881-1894 Fax: 603-881-2790</p>	<p>Has agreement with NeXT to remarket OpenStep; already offers NeXTSTEP on PCs.</p>
<p>Digitalk 5 Hutton Center Suite 1100 Santa Ana, CA 92707 Tel: 714-513-3000 Fax: 714-513-3100</p>	<p>Developer of OO visual development tools using Smalltalk. Main products are Smalltalk/V and PARTS. Supports AS/400, COBOL, CICS and mainframe applications.</p>



## Exhibit B-1 (cont'd)

Company	Notes
<p>Easel 25 Corporate Drive Burlington, MA 01803 Tel: 617-221-2100 Fax: 617-221-3099</p>	<p>Recently entered the OO visual development tools market with its acquisition of Smalltalk-based Enfin. Supports ObjectStudio, a line of development tools that use business objects and Enfin. Also has event-driven ESL line of Windows-based visual development tools.</p>
<p>EDS 5400 Legacy Drive Plano, TX 75024 Tel: 214-605-6000</p>	<p>System integrator with extensive investment in objects.</p>
<p>Forté Software Harrison Street, Floor 15 Oakland, CA 94612 Tel: 510-834-1501</p>	<p>Developing a powerful C/S application development tool for enterprise applications. It is particularly useful for database applications that require active communication between users.</p>
<p>Franz, Inc. 1995 University Avenue Berkeley, CA 94704 Tel: 510-548-3600 Fax: 510-548-8253</p>	<p>Entering the client/server development tools market with visual development tools based on CLOS, an OO version of LISP.</p>
<p>Fujitsu International Computer Systems Group 1015, Kamikodanaka, Nakahara-ku Kawasaki-shi Kanagawa 211, Japan Tel: 011-81-44-754-8585 Fax: 011-81-44-754-8543</p> <p>Fujitsu Open Systems Solutions 3055 Orchard Drive San Jose, CA 95134 Tel: 800-545-OSSI Fax: 408-456-7050</p>	<p>Entering the C/S software market in the U.S. with the Intelligent Pad, a product of Hokkaido University and initially funded by Fujitsu, Hitachi, Vision Corporation and Sapporo Electronics Center Foundation, but now up to 50 members.</p>
<p>Gupta Corporation 1060 Marsh Road Menlo Park, CA 94025 Tel: 415-321-9500 Fax: 415-321-5471</p>	<p>SQLWindows 5.0, announced in May 1994, supports "Quick Objects."</p>
<p>Hewlett-Packard 19310 Pruneridge Avenue Cupertino, CA 95014 Tel: 408-447-4042 Fax: 408-447-5809</p>	<p>Leader in open systems computing. Several OO initiatives for C/S computing—databases, Smalltalk, Taligent and NeXT support.</p>

## Exhibit B-1 (cont'd)

Company	Notes
IBM Corporation 1 Old Orchard Rd. Armonk, NY 10504 Tel: 914-765-1900 Fax: 914-765-4190	Promoting C/S computing as a major strategy. AIX will be the key open systems platform and an OS/2 operating system kernel will allow multiple operating systems to run on a PC or workstation. Major object initiatives with CORBA-compliant DSOM (Distributed Systems Object Management), together with Taligent's application frameworks, will revolutionize programming, particularly in document-centric applications. This initiative will help integrate corporate data processing with office automation environments using C/S systems.
IDE Interactive Development Environments 595 Market Street, 10th Floor San Francisco, CA 94105 Tel: 415-543-0900 Fax: 415-543-0145	Software Through Pictures (STP) CASE tool based on object technology.
Illustra 1111 Broadway Suite 2000 Oakland, CA 94607 Tel: 510-652-8000 Fax: 510-869-6388	ORDBMS. The analogy is that the database is like a razor and different object families are blades. The first two Datablades to be supported are for image and spatial object storage and retrieval, based on geographic location.
Intellicorp 1975 El Camino Real, West Suite 101 Mountain View, CA 94040-2216 Tel: 415-965-5700 Fax: 415-965-5647	A vendor of visual development tools based on expert system technology.
KnowledgeWare 3340 Peachtree Road Atlanta, GA, 30326 Tel: 800-338-4130 Fax: 404-365-0246	Developer of Objectview 3.0, a client/server application development tool that competes with Gupta's SQL Windows and Powersoft's PowerBuilder.
Lighthouse Design 2929 Campus Drive, Suite 250 San Mateo, CA 94403-2534 Tel: 415-570-7736 foundation@lighthouse.com	A leading developer of software libraries and applications for NeXTSTEP. Provides software and training. Software includes foundation classes, Diagram! (drawing program), Concurrence (presentation and outlining package), and TaskMaster (project management package).
Lotus Development Corporation 55 Cambridge Parkway Cambridge, MA 02142 Tel: 616-577-8500 Fax: 617-225-1213	Notes is a leader in C/S messaging. It is designed primarily as a document database that transfers documents between users. Gupta is working with Lotus to develop C/S development and report-writing tools. Lotus is also integrating its SmartSuite products, having replaced cc:Mail in the suite with Lotus Approach, a relational database for small workgroups to rapidly analyze data.

## Exhibit B-1 (cont'd)

Company	Notes
Magic Software Enterprises 1200 Main Street Irvine, CA 92714 Tel: 714-250-1718 Fax: 714-250-7404	Has over 100,000 users of its MAGIC software for accessing data across networks using Novell or TCP/IP.
Marble Associates 1641 North First Street San Jose, CA 95112 Tel: 408-436-7299	A professional services firm specializing in UNIX networking and NeXT support.
Micro Decisionware 3035 Center Green Drive Boulder, CO 80301 Tel: 303-443-2706 Fax: 303-443-2797	Acquired by Sybase for database gateway products.
Micro Focus 2465 East Bayshore Road Palo Alto, CA 94303 Tel: 415-856-4161 Fax: 415-856-6134	Promotes an alternative approach to OO programming using OO COBOL. Has technology to encapsulate legacy COBOL code as Windows DLLs.
Microsoft Corporation 1 Microsoft Way Redmond, WA 98052 Tel: 206-882-8080 Fax: 206-936-7329	Most successful example of object-like code is Visual Basic's controls, VBXs. Microsoft is encouraging vendors to convert these to OLE controls so that they can be used in more applications.
Neuron Data 156 University Avenue Palo Alto, CA 94301-9968 Tel: 415-321-4488 Fax: 415-321-9648	Visual development tools based on expert system technology. NEXPERT OBJECT is an OO application development tool. Neuron Data's Elements Environment is a modular approach to integrating visual and expert system components.
NeXT Computer, Inc. 900 Chesapeake Drive Redwood City, CA 94063 Tel: 415-366-0900 Fax: 415-780-3714  Ftp: ftp.next.com nextanswers@next.com	NeXT licenses the NeXTSTEP operating environment. Major partners include HP, Digital and SunSoft. Strong support for rapid application deployment and ability to make system enhancements after the application is deployed.
Novell 122 E. 1700 South Provo, UT 84606 Tel: 801-429-7000 Fax: 801-377-9353	Supplier of NetWare, UnixWare and AppWare platforms and tools.

## Exhibit B-1 (cont'd)

Company	Notes
<p>Object Design One New England Executive Park Burlington, MA 01803 Tel: 617-674-5000 Fax: 617-229-2451</p>	<p>OODBMS—Object Store. The largest OODBMS company.</p>
<p>Objectivity 800 El Camino Real Menlo Park, CA 94025 Tel: 415-688-8000 Fax: 415-325-0939 info@objy.com</p>	<p>OODBMS—originally positioned for the engineering market, now expanding into other markets.</p>
<p>ONTOS Three Burlington Woods Burlington, MA 01803 Tel: 617-272-7110 Fax: 617-272-8101</p>	<p>OODBMS—one of the first vendors of the technology.</p>
<p>Open Data Corporation 95 Hayden Avenue Lexington, MA 02173-7967</p>	<p>Provides an OO information retrieval visual development tool.</p>
<p>Open Software Foundation (OSF) 11 Cambridge Center Cambridge, MA 02142 Tel: 617-621-7300 Fax: 617-621-8700</p>	<p>Currently marketing and developing DCE and Motif. DME distributed management environment is not widely accepted. Future is as a technology evaluator and standards coordinator for leading UNIX vendors supporting the COSE initiative. Long-term future unclear.</p>
<p>Oracle Systems 500 Oracle Parkway Redwood City, CA 94065 Tel: 415-506-7000 Fax: 415-506-7151</p>	<p>With 40% of revenues from services, Oracle is expanding its consulting and applications business. It is also expected to be a major provider of multimedia server software based on objects.</p>
<p>ParcPlace Systems 999 E. Arques Avenue Sunnyvale, CA 94086 Tel: 408-481-9090 Fax: 408-481-9095</p>	<p>Leader in Smalltalk development tools with VisualWorks, which is now used to develop C/S applications. Its portability enables it to run without recompilation across multiple hardware environments. Hewlett-Packard uses ParcPlace Smalltalk in its Distributed Smalltalk product.</p>
<p>Persistence Software 1700 South Amphlett Boulevard Suite 250 San Mateo, CA 94402 Tel: 415-341-7733 Fax: 415-341-8432</p>	<p>Develops code to support the interface between C++ objects and relational databases using automatic code generation.</p>

Company	Notes
POET Software 4633 Old Ironsides Drive Suite 110 Santa Clara, CA 95054 Tel: 408-748-3403 Fax: 408-748-3415 info@poet.com or info@poet.de	OODBMS—a German company with a large installed base because the software runs on PCs.
Powersoft 561 Virginia Road Concord, MA 01742-2732 Tel: 617-229-2200 Tel: 800-395-3525 Fax: 617-272-9076 FaxBack 508-287-1600	PowerBuilder, its main client/server development tool, supports class libraries, inheritance, VBX controls, encapsulation of processing logic and polymorphic messaging.
Raima 1605 N.W. Sammamish Road Suite 200 Issaquah, WA 98027 Tel: 206-557-0200 Fax: 206-557-5200	Developer of a database for storing C++ data so that it has persistence.
Sapiens P.O. Box 3365 Santa Cruz, CA 95063 Tel: 408-458-1990 Fax: 408-425-0905	Visual development tool vendor.
Servio Corporation 2085 Hamilton Avenue Suite 200 San Jose, CA 95125 Tel: 408-879-6200 Fax: 408-629-0422	GemStone OO database, strong support for Smalltalk, GeODE code-free visual development environment.
SHL Systemhouse Object Technology Center 4900 Pearl East Circle, Suite 201 West Boulder, CO 80301 Tel: 303-449-2870 x222 Fax: 303-449-5716 OTCCORe@bou.shl.com	Object technology center for SHL. Deploying Smalltalk and NeXTSTEP applications, as well as conventional C++ systems.

## Exhibit B-1 (cont'd)

Company	Notes
SunSoft 2550 Garcia Avenue Mountain View, CA 94043-1100 Tel: 415-960-3200 Fax: 415-336-0362	Potential OO environment vendor with OpenStep, a joint-development effort to run NeXTSTEP on Sun's Solaris. Also supports DOE, Distributed Objects Everywhere, Sun's distributed object strategy.
Sybase 6475 Christie Avenue Emeryville, CA 94608 Tel: 510-596-3500 Fax: 510-658-9441	Leader in databases for C/S computing with Sybase System 10. Momentum products are the foundation for Sybase's OO product line.
Symantec 10201 Torre Avenue Cupertino, CA 95014-2132 Tel: 408-253-9600 Fax: 408-253-4092	Entering the C/S OO development tools market.
Taligent 10201 North De Anza Boulevard Cupertino, CA 95014-2233 Tel: 408-255-2525 Fax: 408-777-5082	Developing application frameworks initially for document-centric system development. IBM will be an early marketer of Taligent's technology that started as an operating system project code-named "Pink" at Apple.
Trinzic 101 University Avenue Palo Alto, CA 94301 Tel: 415-328-9595 Fax: 415-321-7728	Recently entered the market with a visual development tool.
UniSQL 9390 Research Boulevard Suite II-200 Austin, TX 78704 Tel: 512-343-7297 Fax: 512-343-7383	Has an ORDBMS that connects C++ or Smalltalk to relational databases.
Versant Object Technology 1380 Willow Road Suite 201 Menlo Park, CA 94025 Tel: 415-329-7500 Fax: 415-325-2380	OODBMS—licenses databases for networking and telecommunications support. Also for applications that use navigation requiring higher speed than relational databases.

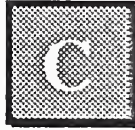
Exhibit B-2

## Names and Addresses of Organizations

Company	Members
<p>ASSET 2611 Cranberry Square Morgantown, WV 26505 Tel: 304-594-1762 FAX: 304-594-3951</p> <p>info@source.asset.com Modem access: 304-594-3642</p>	<p>An ARPA-sponsored software library to promote re-use of software components, including objects. It can be reached electronically over Internet using ftp to: ftp.source.asset.com Documentation is /pub/asset_user_guide.txt</p>
<p>Object Database Management Group (ODMG) 13504 Clinton Place Burnsville, MN 55337 Tel: 612-953-7250 Fax: 612-397-7146</p> <p>info@odmg.org</p> <p>ODMG standard is available from</p> <p>morgan@unix.sri.com</p>	<p>Voting Members: O2 Technology (France), Object Design, Objectivity, POET Software, Servio, SunSoft (Rick Catell, Chair), Versant</p> <p>Reviewer Members: Andersen Consulting, EDS, HP, Itasca Systems, MICRAM Object Technology (Bochum, Germany), Persistence, Sybase, Texas Instruments</p>
<p>Object Management Group (OMG) 492 Old Connecticut Path Framingham, MA 01701 Tel: 508-820-4300</p>	<p>The leading standards body for distributed objects. Has a subgroup that works on business objects.</p>

(Blank)





## Detailed Forecasts

This appendix provides details on the forecasts.

### A

#### U.S. Forecasts

Exhibit C-1 shows the forecasts and growth rates for the three categories of software analyzed in the report: OO operating environments, visual tools and ODBMSs. The tables provide detailed data reflected in Exhibits VI-7 and VI-8.

Exhibit C-1

#### Market Forecast for OO Platforms—U.S. 1994-1999

	1994	Growth Rate 94-95	1995	1996	1997	1998	1999	CAGR
	\$M	%	\$M	\$M	\$M	\$M	\$M	%
OO Operating Environments	32	31%	42	132	260	610	685	85%
Visual Development Tools	640	48%	950	1,362	1,770	1,947	1,977	25%
ODBMSs	189	71%	323	581	798	1,004	1,354	48%
<b>Total</b>	<b>861</b>	<b>53%</b>	<b>1,314</b>	<b>2,075</b>	<b>2,828</b>	<b>3,562</b>	<b>4,016</b>	<b>36%</b>

**B****Worldwide Forecasts**

Exhibit C-2 shows worldwide forecasts and growth rates.

Exhibit C-2

**Market Forecast for OO Platforms—Worldwide 1994-1999**

	1994	Growth Rate 94-95	1995	1996	1997	1998	1999	CAGR
	\$M	%	\$M	\$M	\$M	\$M	\$M	%
OO Operating Environments	40	50%	60	220	520	1,220	1,370	103%
Visual Devt. Tools	777	57%	1,221	1,990	2,996	3,445	3,790	37%
ODBMSs	233	81%	422	759	1,104	1,391	1,934	53%
<b>Total</b>	<b>1050</b>	<b>62%</b>	<b>1,703</b>	<b>2,970</b>	<b>4,620</b>	<b>6,056</b>	<b>7,094</b>	<b>47%</b>



