

# Whatever Happened to Object-Oriented Databases?

Neal Leavitt

A couple of years ago, industry observers touted object-oriented databases as a technology on the rise, well suited for the emerging Internet age.

They said object-oriented database-management systems (ODBMSs) would soon become the primary database technology, supplanting relational database-management systems (RDBMSs), which were not designed to handle the type of multimedia data frequently found on the Internet. As further evidence of this, they said the growth of intranets signaled a decline in the use of client-server networks, on which most relational databases were used.

Fast-forward to today, and none of these predictions has come to pass.



Relational databases are still by far the most widely used databases. Meanwhile, object-relational database-management systems (ORDBMSs) have added object capabilities to relational databases. They

are gaining in popularity and are expected to outsell even relational databases by 2003. And OO databases (see the "OO Database Orientation" sidebar) are still minor players with solid but strictly niche markets. Sales of relational databases have grown considerably faster than the sales of OO databases, and annual worldwide RDBMS revenues are now about 50 times larger.

Rick Cattell, distinguished engineer at Sun Microsystems, indicated, "Object-oriented databases are doing just fine, and the news of their demise is highly exaggerated. While their market [share] isn't as big, they continue to be used in areas like CAD (computer-aided design) and telecommunications, where RDBMSs are not well suited."

However, said Michael Stonebraker, chief technology officer at Informix and an ORDBMS proponent and pioneer, "ODBMSs occupy a small niche market that has no broad appeal. The technology is in semi-rigor mortis, and ORDBMSs will corner the market within five years."

## DATABASE MARKETPLACE

As Figure 1 shows, IDC, a market research firm, reported global 1999 sales revenue of \$11.1 billion for relational and object-relational databases, but only \$211 million for OO databases. By 2001, IDC expects these totals to increase to \$15.6 billion and \$265 million, respectively. Through 2004, IDC predicts annual growth rates of 18.2 percent for relational databases and only 12.5 percent for object-oriented databases. (These figures are based on data IDC [http://www.idc.com] gathered through 5 May 2000 for Report No. 22542, "Enterprise Database Management Systems Market Forecast and Analysis, 2000-2004.")

## OO databases' niche markets

OO databases have not become major players in the database market. However, they do have niche markets, said Larry Alston, chief technology officer of exCelon (http://www.exceloncorp.com), a provider of e-commerce products and services, including OO databases.

Because OO databases handle complex objects particularly well, they can manage complex data relationships effectively,

## Relating to Relational Databases

A relational database-management system (RDBMS) includes a collection of data items organized as a table, with the columns representing data categories and the rows representing the data itself. For example, a table might contain information about product orders, with the columns representing product types, customers, dates of sale, and prices.

Users can access data in the order in which it was entered in a table or reassemble it in many different ways for

examination from multiple perspectives.

Relational databases are good for managing large amounts of structured, alphanumeric data. For example, companies use them to maintain records of transactions or personnel files.

However, relational databases are rigid because their only data structure is tables. And they work only with limited, simple data types, such as integers, and thus have had trouble handling complex and user-defined data types, including multimedia.

## OO Database Orientation

An OO database-management system (ODBMS) supports the modeling and creation of data as objects. Users can support new media types with OO databases simply by creating new objects.

With OO databases, the application and the database use exactly the same object model. This isn't the case with relational databases, with which users must utilize an object model for the application and a relational-data model for the database. Users thus must develop mapping procedures between the object and relational models.

RDBMS programmers sometimes spend more than 25 percent of their coding time mapping program objects to the database, said Carl Olofson, program director of information and data management software for IDC, a market research firm.

"The result for ODBMSs is less code to develop, reduced development time, and reduced maintenance costs," said Doug Barry, executive director of Barry & Associates consultants and also chair and executive director of the Object Data Management Group (ODMG), an OO database-standards organization.

Meanwhile, OO databases are well suited for use with applications that must manage complex relationships among data objects.

"If you're modeling a Boeing 747 with an ODBMS, the relationships between aircraft parts are directly managed [by the database]," said Akmal Chaudhri, a database expert and visiting scholar at The

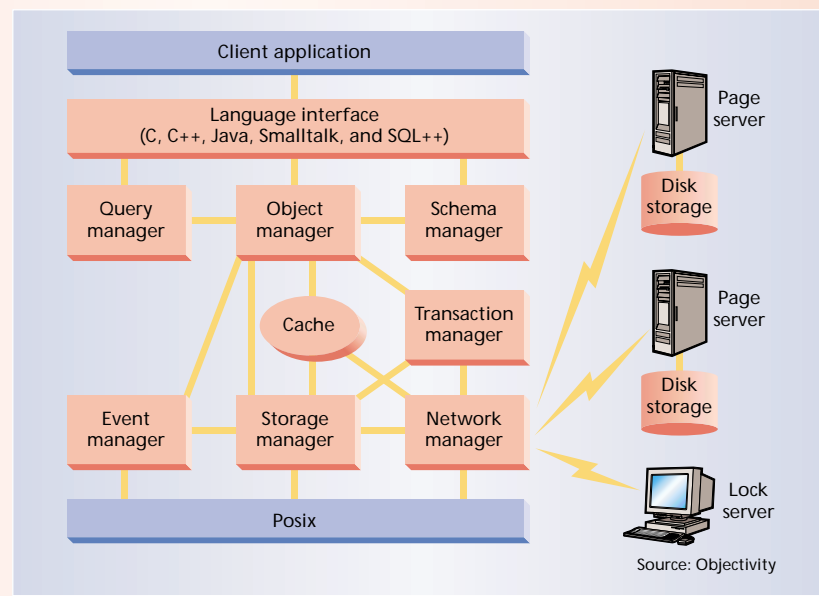
City University in London. With a relational database, he said, you have to decompose the aircraft into tables and then join the tables when you need to reconstruct the aircraft.

However, OO databases don't scale up to high transaction volumes and user counts as well as relational databases, said Philip Russom, director of data ware-

housing and business-intelligence services for the Hurwitz Group consultancy.

For this and other reasons, although OO databases excel at handling some data types, they have not become major players in the database market.

Figure A illustrates the type of architecture used in an OO database—in this case, Objectivity's distributed ODBMS.



**Figure A. Objectivity's distributed database demonstrates important differences between relational and OO databases. For example, unlike relational databases, Objectivity's database requires an object manager, which directly creates, names, and manipulates objects as required by the client application. Also, Objectivity's storage manager can handle clusters of objects of varying sizes. Relational databases' storage managers are built like spreadsheets and tend to work best with data elements of similar size and structure.**

said Leon Guzenda, chief technology officer of ODBMS vendor Objectivity.

OO databases are thus popular for use with artificial intelligence and CAD/CAM (computer-aided design and manufacturing) applications, which entail complex data relationships, he said. CAD/CAM applications also use multimedia data types, which OO databases work with effectively.

Meanwhile, Sun's Cattell said, hospital patient-care tracking systems use OO databases because they are easier for medical personnel to work with than relational databases.

"Companies in London like J.P. Morgan, Chase [Manhattan], and Citibank are using ODBMS technologies in modeling financial instruments [such as derivatives and bonds]," said Akmal Chaudhri, a database expert and visiting scholar at The City University in London.

The companies use object-oriented analysis and design to model these products because object orientation helps effectively capture the instruments' structure and behavior, Chaudhri said. Object orientation also provides mechanisms such as inheritance for modeling new

instruments quickly and easily, which helps companies get these products to market quickly.

### Technical issues

Several technical issues have led to OO databases' limited strength in the database marketplace.

**Object-relational databases.** RDBMS vendors began developing and marketing OR databases in part in response to the perceived threat from OO databases.

OR databases work via an object layer that sits atop a conventional tabular relational engine. Vendors integrate OO fea-

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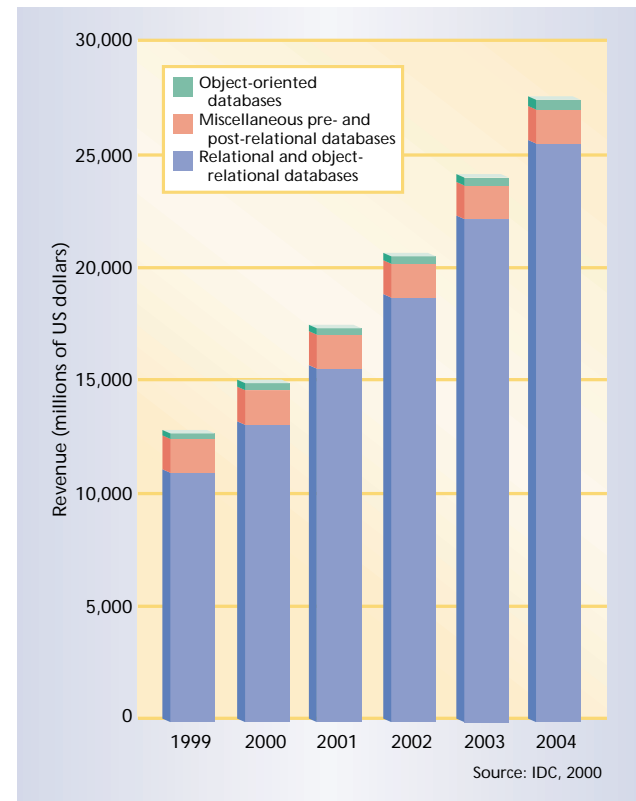
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## Industry Trends



**Figure 1. IDC, a market research firm, predicts steady growth for object-oriented databases and for relational and object-relational databases through 2004. However, IDC predicts that relational and object-relational databases will continue to dominate the market.**

tures into the databases via software modules (such as Informix's DataBlades or Oracle's Cartridges), each designed to handle video, audio, text, or other types of media. So, in addition to handling the numerical data generally used in relational databases, OR databases can handle multimedia data types.

**Performance.** OO databases can store data sets in their entirety and thus typically run faster than relational databases, which must break data sets into parts for storage within tables and then reassemble them in response to queries.

In addition, said Sun's Cattell, OO databases can automatically cache data in the client application's memory, thereby eliminating extra calls to the DBMS's back end and speeding up responses.

And OO databases use optimizers that determine the best way to use a database's indices and physical layout to satisfy a query.

However, relational databases have reduced OO databases' performance advantage with improved optimizers. The optimizers improve ways of finding information within relational databases' tables and indices.

**Standardization.** Relational databases use the long-established SQL (Structured Query Language) standard, which has been adopted by the International Organization for Standardization (ISO) and the American National Standards Institute (ANSI). SQL, used for querying and updating a relational database,

serves as a user interface and application program interface to an RDBMS.

The Object Database Management Group has developed ODMG standards for object-database and object-relational-mapping products since 1993.

However, the Object Database Management Group hasn't promoted ODMG widely within the ODBMS community and needs more vendors on board to make the standard an important factor in the industry, said Philip Russom, director of data warehousing and business-intelligence services for the Hurwitz Group consultancy.

For example, he said, the group created an OQL (Object Query Language) standard, but very few database vendors implemented it.

"A much bigger problem is that the vendors behind ODMG represent zero billion [dollars] in revenue while the vendors behind SQL . . . represent several billion in revenue," said Informix's Stonebraker. "Hence, it is not a standard with critical mass in the marketplace."

### Business issues

"OO systems have not focused on bread-and-butter traditional business-data processing applications where high performance, reliability, and scalability are crucial," Stonebraker said. "This is a large market where relational systems excel and have enjoyed wide adoption."

"Companies are justifiably loathe to scrap such systems for a different technology, unless it offers a compelling business advantage, which has rarely been demonstrated by OO systems," he said. "As such, relational systems and their OR descendants continue to be the market leaders."

Meanwhile, because relational databases have a much bigger installed base, RDBMS vendors have more money and marketing clout than ODBMS vendors.

And with their bigger installed base, more tools are available for relational databases, for such functions as administration and Web development.

Hurwitz's Russom thinks OO databases will continue to be used mostly in niche markets and that their adoption has peaked. "With this impending downturn in the ODBMS life cycle, many ODBMS vendors are scrambling to develop new products or repositioning existing offerings to create new revenue sources as revenue from ODBMSs' slow down."

"Relational vendors realized that objects are important and added them, producing OR systems," Stonebraker said. "However, the failure of OO vendors to realize the importance of SQL and the needs of business-data processing has hurt them immensely." \*

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