INGRES

The Distributed
SQL Relational
Database System

Press Kit

**Relational
Technology**

THE ÏNGRES ADVANTAGE

Volume II, Number 1, 1987
Relational Technology

ÏNGRES

*Your corporate data
management solution
now includes PCs…*

**INGRES for
Personal
Computers**

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<u>FOR IMMEDIATE RELEASE</u>
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RELATIONAL TECHNOLOGY BRINGS INGRES TO PCs, INTEGRATING THEM WITH CORPORATE COMPUTING POWER

Software Can Help Solve
Data Management Problems

ALAMEDA, California, February 17, 1987 -- Relational
Technology Inc. today introduced INGRES for Personal Computers, a
new generation of PC relational database software. It allows
users to get full use of mainframe database management system
(DBMS) capabilities on the PC and integrate PCs into the

INGRES

Your corporate data management solution now includes PCs…

INGRES for Personal Computers

Relational Technology

*I*magine having the functionality of a mainframe database product on your PCs. One that both your end-users and developers could use. And one that's incredibly fast and efficient.

And what if you could include your PC resources in a distributed network, reducing the load on your mainframes and minis while saving the company thousands of dollars in development time.

Just envision being able to provide your end-users with a sophisticated database tool that's as easy to use as Lotus 1-2-3. A product that lets them get at the corporate data they really need.

Imagine no longer. Because now you can bring the power of the most advanced relational database for mainframes and minis to your PCs–with INGRES, the "Distributed SQL Relational Database System" from Relational Technology.

Distributed database gives you compatibility and flexibility

Whether it's used as a stand-alone database management system, provides access to remote databases, or helps to distribute the processing load of more costly mainframe and mini-computer resources, INGRES extends the distributed database capabilities of your organization while making the most of your PC investment.

INGRES is available in a variety of environments including PCs, workstations, mini-computers and mainframes, and works the same way in each. Compatibility across machines means applications can be developed on a PC and then passed to a mainframe–or vice versa–providing a cost-effective environment for application developers.

With distributed database, users get transparent access to information anywhere in the organization–without having to know where that information is located, or how to get it. And with distributed database you can use PCs for application processing functions, and then call on the power of mainframes or minis for database processing. So your PC becomes an important information processing tool, not just a terminal emulator.

Plus, with INGRES for PCs, the information in both local and corporate databases can be used with popular PC productivity software like spreadsheets, word processing programs and graphics packages.

INGRES Supported Environments:

Mainframes

IBM	9370, 370, 43xx 30xx	VM/CMS, VM/IS, MVS, UNIX
DEC	VAX 8974, 8978	VAX/VMS, Ultrix, UNIX System V, 4.x BSD
AMDAHL	470, 580	VM/CMS, MVS, UTS

Minicomputers

DEC	8000 Series, VAX 11/7xx	VAX/VMS, Ultrix, UNIX System V, 4.x BSD
AT&T	3B5, 3B15, 3B20	UNIX
Data General	MV Series	DG/UX, AOS/VS
HP	9000 Series	HP/UX
Alliant	FX Series	Concentrix
Computer Consoles	Power 6/32	UNIX
ELXSI	6400	ENIX, Embos
Gould	PowerNode Series	UTX/32
ICL	Clan Series	UNIX
Pyramid	Workcenter, 90 Series	OSx
Sequent	Balance Series	DYNIX
Unisys	5000, 7000, XE550	UNIX, CTIX

Microcomputers, Workstations, Personal Computers

IBM	PC/XT, PC/AT, RT PC (100% Compatibles)	PC DOS, MS-DOS, AIX
IBM	3270/PC	
DEC	MicroVAX, VAXStation, VAXMate	VAX/VMS, Ultrix, UNIX; MS-DOS
AT&T	6300 Series, 3B2	MS-DOS, UNIX
Compaq	All Models	MS-DOS
HP	Vectra Series	MS-DOS
Apollo	DN Series	DOMAIN/IX
Computer-Vision	CDS3000	UNIX
NCR	Tower 32	UNIX
SUN	SUN-2, SUN-3	UNIX

Integrated tools mean extraordinary productivity for both application developers and end-users

INGRES offers the most sophisticated set of tools for application development available in the PC marketplace. And its end-user decision-support tools make it easy for the sophisticated end-user.

For application developers, INGRES provides an extremely cost-effective solution, letting you create applications orders-of-magnitude faster than other methods. 4GL and Embedded Language support allows rapid prototyping of applications, complete with customized forms and full database functionality.

For end-users, Visual Programming tools make it easy to run queries and reports–even create entire applications–using a forms design approach. And the Lotus-style user interface of INGRES for PCs means instant productivity.

INGRES SQL combines high performance and flexibility with ease of use

Unlike other PC database products, INGRES for PCs includes a broadly compatible implementation of the SQL database language. And compatibility with IBM's DB2, ANSI and X-OPEN SQL standards means your investment is protected now, and in the future.

In addition, the product has been carefully designed to take maximum advantage of the PC and MS-DOS environment. Independent tests prove INGRES for PCs is the fastest full-function personal computer data management tool on the market.

INGRES uses artificial intelligence techniques to determine the most efficient way to execute a query, and whether to use indexes, scanning tables, join methods or sorting. You can also tune INGRES to increase the speed of your applications even more.

Support and training you need to succeed

Relational Technology offers a significantly higher level of training and support than most companies–because it's familiar with meeting your organization's overall information management needs.

For DP professionals, Relational Technology provides the technical documentation, hotline telephone support and utilities needed for maximum productivity.

And Relational Technology provides the support for end-users, those who enter information and use applications on a daily basis and those who occasionally retrieve information from the database. It begins with computer-assisted instruction which proceeds at the user's pace. Next comes complete, easy-to-understand documentation to meet the needs of a variety of users.

Relational Technology also organizes and supports the INGRES User Association. Biannual meetings provide a forum for sharing valuable INGRES knowledge and ideas. In addition, *The INGRES Advantage* quarterly newsmagazine provides new product updates, informative application stories and timely technical articles. You can even arrange for customized, on-site training.

Relational Technology not only provides superior database products, but is your technology partner in meeting your organization's information management needs.

INGRES: The power of a mainframe database in a PC.

INGRES for Personal Computers is the same INGRES that runs on much larger machines. Fourth generation language. Integrated, visually-oriented tools for applications development. The fastest full-function database available. INGRES has what you need for your individual, departmental and corporate data management needs.

For more information on the NEW corporate standard for information management call **800-4-INGRES.**

Specifications:

Minimum Hardware:
• IBM PC XT, PC AT or 100% compatible computer with 640K internal memory and hard disk; as little as 350K internal memory for run-time applications.

Disk Space Requirements:
• 6MB required for full application development system; as little as 500K for run-time applications.

ÍNGRES

THE ÏNGRES ADVANTAGE

Chrysler's Factory of the Future

In January, Paul E. Newton joined Relational Technology as president and chief operating officer. Former president, Gary Morgenthaler was named Chairman of the Board of Directors and continues as chief executive officer. Mr. Newton brings with him over 20 years of experience in the software industry, most recently at UCCEL Corporation, where he was senior vice president and general manager of the Systems Software Group.

elational Technology is pleased to unveil INGRES for Personal Computers in this issue of The INGRES Advantage. INGRES for Personal Computers represents another major milestone in the implementation of our corporate strategy.

Relational Technology's strategy is to provide major corporations and government organizations with a single integrated and distributed database solution.

The features of INGRES that make this strategy work are its open-architecture distributed capability for tying together data from multiple, dissimilar computers; integrated tools for high-productivity application development and end-user decision support; and a high-performance SQL-based relational database engine. INGRES for Personal Computers supports all of these features.

First is the open-architecture distributed database capability. INGRES for Personal Computers is designed to operate in a distributed world. PC users can use minicomputer and mainframe data within their PC applications easily and transparently.

INGRES's integrated tools are fully incorporated in the PC version. For the first time, PC users have a powerful 4GL application development environment on the PC. INGRES applications can be developed in the low cost PC environment and moved without change to the mini or mainframe.

And INGRES's SQL-based RDBMS is the best performing database product for sophisticated applications in the PC marketplace.

Beyond simply bringing the full power of INGRES to the PC, we've also adapted INGRES to meet the needs of PC users. We've added a familiar ring-menu interface in addition to the "Classic INGRES" menu. We've written an entirely new set of documentation specifically for PC users. And we've developed a state-of-the-art computer-based training tutorial for novice INGRES users.

The availability of INGRES for Personal Computers enables PCs to be fully integrated in the corporate computing environment. And it further enables our customers to use a single integrated and distributed database solution across their organization.

I am proud to be joining Relational Technology at this exciting time in the company's growth. I believe our company has the finest products, the best people and the strongest commitment to customer success and satisfaction in the industry. And I am committed to maintaining our leadership position in these areas.

Paul E. Newton

Paul Newton

THE *INGRES* ADVANTAGE

Relational Technology expands its support for heterogenous computer systems with INGRES for PCs.

Chrysler uses INGRES to manage manufacturing processes.

Technology partnership means new horizons for Carnegie-Mellon University.

C O N T E N T S

ÍNGRES

AVAILABLE FOR

PCs

INGRES, the Distributed SQL Relational Database System, has increased productivity and accelerated applications development in thousands of organizations worldwide. Available for a number of key computer environments, INGRES offers users a sophisticated open architecture distributed database, integrated tools and a high-performance SQL product for comprehensive data management.

And now, INGRES is available for IBM Personal Computers and compatibles, enabling complete data and application portability and distributed data access between PCs, mainframes, minicomputers and workstations.

"The bottom line is that INGRES, is INGRES, is INGRES whether it's used on micros, minis or mainframes," says P. Michael Seashols, vice president of sales and marketing for Relational Technology. "INGRES for PCs operates in the same way, and provides the same capabilities as INGRES in any other environment. The applications and user interfaces work exactly the same way whether the data is located in a local database on the user's PC, or in a remote database on another computer connected to the PC through a network."

"We're very excited about INGRES for PCs," adds Group Product Marketing Manager Ed Forman. "The essence of INGRES is exactly the same in this new product, while at the same time we've done some very special things to take advantage of the personal computer environment."

INGRES: The Single Solution

INGRES is designed as a single data management tool which operates across all strategic operating environments in most computing organizations.

Its open architecture distributed database allows transparent, simultaneous access to data on multiple computers and operating systems. Because INGRES applications and end-user tools are compatible across environments, development time and usability are greatly enhanced. It also ensures that applications designed to run on a mainframe can operate unchanged on a mini, microcomputer or workstation.

The INGRES integrated tools provide not only a sophisticated fourth-generation application development environment, but a complete family of end-user tools for decision-support. The 4GL applications environment encompasses multiple levels of tools ranging from Visual Programming and 4GL, to embedded language interfaces for third generation languages. For end-user decision support, INGRES offers utilities for query, reporting and data extraction from a host computer to work with personal productivity packages like Lotus 1-2-3.

At the heart of INGRES is a high-performance SQL database compatible with IBM's DB2. Applications can be moved between INGRES and DB2 with minimal effort. As a result, INGRES can complement DB2 in an organization by running the same applications on mini-

and microcomputers as DB2 runs on the mainframe. In addition, organizations can choose INGRES as their single database management system running on all computers from mainframes to micros. The INGRES SQL also complies with the ANSI and X-OPEN SQL standards, ensuring current and future investments are protected.

Multiple Levels of Use

"Relational Technology has carefully analyzed its customers' PC needs and ways in which they plan to use the PC in their database environment," emphasizes Forman. "From these ongoing research projects, Relational Technology has designed and developed a family of software products to accommodate those needs."

INGRES for PCs will be used primarily in these four situations:

· INGRES for PCs extends the INGRES/STAR distributed environment to the personal computer, allowing users to run applications on their PC which access distributed data within a computer network. The data appears as if it resides on the PC; however, the data may be anywhere in the distributed database. The processing load on expensive mainframe and minicomputers is reduced, while the PC is used more effectively as a real processing tool instead of a terminal emulator.

· It's ideal for developing INGRES applications – regardless of whether they will be ultimately used on mainframes, minicomputers, workstations or PCs – offering an efficient and cost-effective way of utilizing valuable machine resources. As one user notes, "we can save a lot of money developing applications on the PC or workstation, then port the application to the mini or mainframe when we're ready for production."

· INGRES for PCs provides a powerful stand-alone database system fine-tuned for developing and deploying single-user applications and for training INGRES users.

· It is also a bridge to connect users of PC productivity software, such as Lotus 1-2-3, Multiplan, dBASE II/III, WordPerfect and Wordstar, to INGRES data.
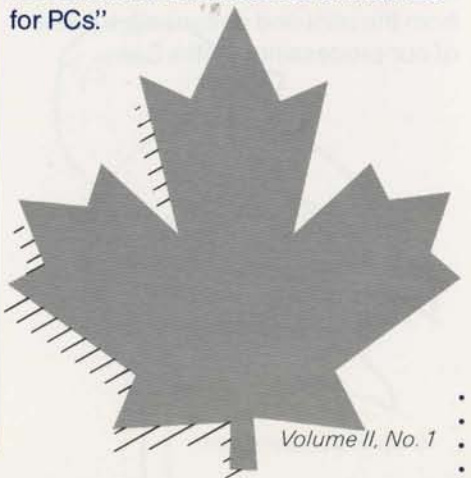
Agriculture Canada

Agriculture Canada is a Canadian government agency very similar to the U.S. Department of Agriculture, and spearheads a multitude of projects in that country from research to agricultural business programs. The first Canadian government agency to purchase an INGRES license, data systems personnel at Agriculture Canada have spent the last several months "beating [INGRES for PCs] to death."

"INGRES for PCs works exactly like the VAX product," reports Steve Almond, chief of database administration. "In fact, Relational Technology has left the nice parts of the product alone, while actually making some of the more cumbersome operations easier. It's very beneficial from a technical standpoint that all directories and subdirectories are the same. I mean," Almond continues, "how many PC products do you find that have a time zone flag? The functionality of a minicomputer product has been successfully transferred to the PC."

INGRES is used for "literally anything and everything" at Agriculture Canada including corporate project tracking, project reporting and time reporting. "At last count we were supporting over 150 databases, ranging from small, two-user tables to our time reporting system that is used by the entire organization." At each month's end, the time reporting system is rolled up to allow the deputy minister to review high visibility projects within the organization.

"When it comes to a minicomputer solution, INGRES is the answer as far as databases are concerned," Almond continues. "We use INGRES for everything. And we are investigating how we can make the most out of INGRES for PCs."

Computer Sciences Corporation

Computer Sciences Corporation (CSC) supports the computer center at the Naval Ocean Systems Center (NOSC) in San Diego, Calif. The company is a long-time INGRES user with licenses for both the VAX/VMS and UNIX operating systems. Currently, there are approximately 1300 INGRES users at NOSC, including clerical personnel, managers, programmers and application developers.

CSC has written a fiscal database using INGRES for NOSC project research, funding, labor and materials. Information is cross-loaded from the NOSC accounting machines and plugged into INGRES for access centerwide. The center also has many users who utilize INGRES/PCLINK to download information from the fiscal database for working with PC spreadsheet programs.

"I see INGRES for PCs as an application developer's tool," says Joel Saks, responsible for INGRES systems support at CSC. "There are a number of developers who incur a lot of charges on the minicomputer. INGRES for PCs provides a way to off-load the time and charges on the bigger machines. When an application is finished and the bugs are all out," continues Saks, "we can port it to the mini for final production."

The company takes advantage of the INGRES 4GL tools as much as possible in the course of their applications development. They plan on using INGRES for PCs to augment their distributed capabilities as well.

"We see INGRES for PCs and INGRES/NET as a way to off-load applications from the mini and decentralize some of our processing," notes Saks.

Full INGRES Functionality

INGRES for Personal Computers includes six product modules that can be purchased together or separately depending on your applications. These product modules include:

- The INGRES relational DBMS

- The INGRES user interfaces, encompassing interactive SQL and QUEL, Query-By-Forms, Visual-Forms-Editor and the INGRES Report-Writer.

- INGRES/APPLICATIONS including the INGRES 4GL and Applications-By-Forms.

- Embedded SQL and QUEL database language support for the Microsoft C programming language.

- INGRES/NET for distributed processing with host computers.

- INGRES/PCLINK for query and extract to PC productivity software.

INGRES for PCs has been carefully re-architected to take maximum advantage of the PC environment. In addition to the classic INGRES menu structure with menus at the bottom of each screen, INGRES for PCs includes the ability to display menus in a manner similar to Lotus 1-2-3 and other popular PC productivity tools. "Users can easily switch back and forth between the menu styles," adds Forman. "Users who are accustomed to using INGRES via an asynchronous terminal such as the DEC VT100 or the block mode IBM 3270 will be able to interact with INGRES in exactly the same manner. On the other hand, if the user is more accustomed to products like Lotus 1-2-3 or other ring-menu driven programs, they can use INGRES in that way." Availability of the ring-menu interface should make it much easier to train PC users to work with INGRES applications and data.

For networking PCs with other INGRES systems, INGRES/NET will initially support the asynchronous protocol called BLAST – a widely-accepted product for asynchronous communications between PCs and host computers. The BLAST protocol – an easily installed protocol that can be used to connect all INGRES environments – is provided by Relational Technology as part of the asynchronous support.

Extraordinary Performance

Relational Technology invested considerable time designing INGRES for PCs to function efficiently within the 640K memory limitation of the personal computer (see "Built for Speed" on page 6). The result is the fastest full-function relational database product on the market – INGRES for PCs.

"Even preliminary benchmarks performed when the product was still in its infant stages proved INGRES for PCs was beating out its competitors on complex applications by a margin of five-to-one," remarks Steven Vandor, product marketing manager for PC products. "In many cases, the competition couldn't even handle fairly standard tasks. We have a stronger product from both a performance and functionality standpoint than anybody else out there."

"INGRES for PCs is incredibly fast," adds Charles Nocera, an INGRES Value-Added Reseller who began transferring his accounting systems to the PC as soon as the beta version of the new product became available in June, 1986. "Even as a beta product INGRES for PCs withstood the ultimate performance tester:

Enhanced Systems and Services
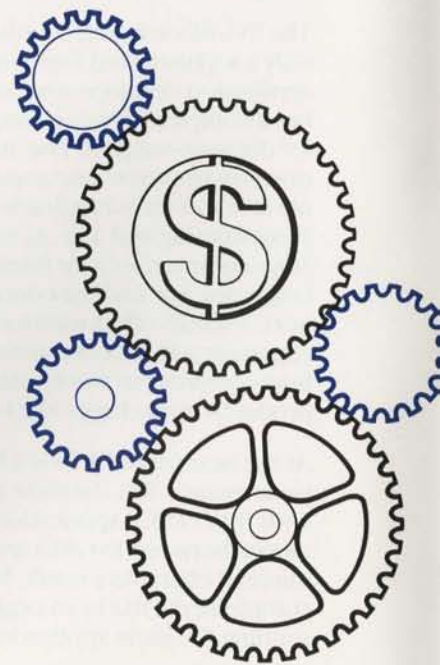
my customers and end-users." Over 700 organizations participated in the exhaustive pre-release testing of the product.

In addition to taking maximum advantage of the MS-DOS environment, INGRES for Personal Computers will enhance host performance by running application processes on the personal computer and utilizing the back-end on larger machines more efficiently. And by off-loading applications which are single-user in character there will be more resources in multi-user environments available for larger, multi-user applications.

Requirements

INGRES for Personal Computers will operate on IBM PCs, PC/XT, PC/AT or any 100 percent compatible computer. 640K of memory is required to build applications and 6MB of disk is required to store the entire set of INGRES for PC modules. End-user applications can be designed that require as little as 500K of disk and 350K of memory. For connection between INGRES databases on multi-user computers and personal productivity products on PCs, INGRES/PCLINK requires only 320K. It requires the PC DOS or MS-DOS operating system.

Expanding Your Corporate Data Management Solution

"INGRES for PCs expands your corporate data management solution to include PCs," notes Forman. "Future enhancements of the product will include support for a greater number of traditional programming languages and support for multi-user capabilities in the MS-DOS environment." INGRES for PCs will support the new 286-DOS or A-DOS operating systems when they become available, as well as windowing facilities like Microsoft Windows.

In addition, the INGRES for Personal Computers product includes an entirely re-designed set of documentation, as well as a self-paced on-line training program.

"Whether you use INGRES for PCs as an extension of your distributed capabilities, to create independent applications or to train your INGRES end-users," concludes Forman, "INGRES for PCs is the fastest full-function database product you could hope for."

ARA Services

ARA Services is a multifaceted organization with its fingers in almost every service-oriented business imaginable. The company maintains one of the largest food service businesses in the world, supplying schools, hotels, colleges and recreation areas. One division of ARA provides full-service hospital support, including uniform rental, sickroom supplies, janitorial and food services. Another division manages the concessions at major stadiums and parks all over the country.

In its corporate headquarters alone, ARA has over 100 "very educated" personal computer users. The company is looking forward to the portability INGRES has to offer.

"Right now we're using R:Base on our PCs," says Merritt Wolfe, manager of corporate systems planning and development at ARA. "And the problem is that to move an application over to our VAX or IBM systems we often have to rewrite it. With INGRES running on the PC we can port applications over to our other systems."

"Currently, ARA uses INGRES for financial applications," says Wolfe. "We extract information from our general ledger financial systems." Applications include a purchasing control system which provides accumulated food purchasing data from over 2000 remote locations. In addition, ARA has a system which tracks information for its legal department, including current litigation and outside legal counseling information.

"We can see that INGRES for PCs could be very useful in our organization," adds Wolfe.

Enhanced Systems and Services (ESS), owned and operated by INGRES Value-Added Reseller Charles Nocera, is a four-year-old company that markets Finesse—an accounting and manufacturing application program which uses INGRES as its base.

For ESS, the INGRES for PCs product means greater marketing and profit potential.

"I think the INGRES for PCs product is of strategic importance for both my company and Relational Technology," says Nocera. "Organizations will want to run it as a stand-alone product as well as with their minis or mainframe computers."

Nocera plans to use the product as both a development and marketing tool. One of the first organizations to test INGRES for PCs, Nocera ported a number of INGRES applications from the VAX to the PC in a weekend's time. "I recently developed an entire personnel package on the PC and successfully ported it to the VAX," Nocera notes.

ESS plans to use the product as both a development and marketing tool. "Now our prospective customers can try out our applications on PCs. It expands the product line and mix we have to offer. And we can get a lot more MIPS from development on the PC, while at the same time provide a more portable product to our customers." According to Nocera, there is a tremendous demand for the high-performance and broad functionality of INGRES for PCs among developers of sophisticated applications.

In total, four people at ESS use INGRES to develop applications for the DEC VAX, UNIX and PC environments. The group has been impressed with the user-friendliness of the new INGRES PC tool and have been even more impressed with its performance.

"I think for a PC product, INGRES is really fast," emphasizes Nocera. "I have nothing but good things to say about the entire new package."
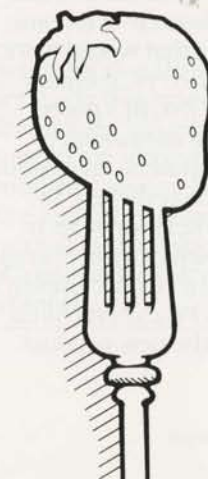
BUILT FOR SPEED

by
Steven Vandor

Bob Kooi and John Newton,
chief systems architects for
the INGRES product on PCs.

INGRES for Personal Computers ushers in a new era in database computing. Besides its position as the fastest relational database available on PCs, INGRES now allows organizations to incorporate PC hardware into their overall data processing strategy. This ability derives from the fact that complete INGRES functionality is preserved in the MS-DOS environment.

The job of designing INGRES for the personal computer was really two parallel efforts, each a triumph in applied technology and human ingenuity. The first task involved making the INGRES data manager, the back-end, as fast as possible. The second task required bringing the application tools and productivity environment – tools that set INGRES apart from other products on the market – into the demanding environment of the personal computer.

The most significant obstacle INGRES engineers would ultimately overcome was devising a system that would work effectively in the limited PC memory space of 640K. Since INGRES potentially occupies several *megabytes* of memory on minicomputers, the system architecture had to be reviewed. To meet this challenge, Relational Technology assembled a select team of engineers, combining some of the company's brightest talent with PC experts hired specifically to build the new product.

The monumental job of designing a fast and complete version of INGRES for personal computers began almost two years ago. Working from a simple, early version of INGRES, Dr. Robert Kooi, Relational Technology's principal performance engineer, refined and enhanced the architecture of the INGRES data manager, developing a functionally complete version of the product while keeping in mind the size constraints of the PC.

By design, INGRES for Personal Computers had to be capable of accomplishing serious work that heretofore could only be assigned to larger computers. The product had to be designed so that a "reasonable" amount of memory would always remain available for user applications and data. After allowing 40K for the operating system, the team, led by John Newton, concluded that if the data manager could be engineered to work in 220-230K, over 350K would still be available to the user. Here, then, was Dr. Kooi's target.

As the data manager and query optimizer were designed, built and enhanced, a system of program *overlays* were put in place. This technique allowed that at any given moment, only 70-80% of the entire body of data manager code had to be in memory. Sections of the code not immediately needed could be transfered in and out of memory. In fact, this system of overlays is one of the most crucial and sophisticated parts of the new product.

What emerged over a year later from this concentrated effort was the fastest, most sophisticated data management system yet seen on PCs. In independent testing conducted at the University of Stuttgart, West Germany, during the spring and summer of 1986 against such products as Oracle, dBASE III, Informix and R:Base 5000, INGRES was determined the highest performer by far. "INGRES raised itself above the others through consistently good results," the benchmark reported. "...INGRES left all other competitors far behind. This fact proves the assumption that INGRES has the best query optimizer and possesses a very good storage structure."

But this remarkable speed is only half the story of INGRES for Personal Computers. There was still a need to provide users with the special set of INGRES tools for application development and end-user decision support. Here, a new set of challenges presented themselves.

The first of these involved how to run more than one program on a PC concurrently. Unlike larger, multi-user computers, PCs can execute only a single task at any given time. The entire architecture of the INGRES system – wherein one program (the "front-end" application), communicates with another (the

data manager) – appeared to be in peril.

The solution to this problem lay in a strategy built on the DOS capability called "terminate and stay resident." Under this scheme, the INGRES data manager is loaded into memory, but does not open any database. Instead, control is immediately returned to the operating system and the user can start up whatever application is needed using any database. The data manager remains poised in RAM, ready to respond to whatever task is sent to it from the application.

Once this basic architectural hurdle was cleared, the way seemed open to re-program the INGRES integrated tools (Query-By-Forms, Application-By-Forms, Visual-Forms-Editor (VIFRED), Report-Writer, etc.) for the PC environment. But again, it became incumbent upon the engineering staff to develop some new technology to keep the system up to the standards INGRES users had come to expect.

For example, it was necessary to design a way for a user to switch between programs quickly and easily in the midst of an application. For instance, while using Applications-By-Forms, a user might want to edit a form with VIFRED first, then edit an INGRES 4GL source code file, then compile a new frame – all under the security and direction of

the INGRES/APPLICATIONS environment. If the user had to constantly exit and re-enter these various programs, the productivity gains INGRES provides might be seriously undermined.

The solution lay in developing a new set of routines that could be used commonly by any INGRES application. Dubbed "P-switch," these routines allow a user or an application to exit from one program and start another, and upon returning to the original program return to exactly the same place. To the user, it appears a new process or shell has been spawned, similar to INGRES's behavior on larger machines.

Another major effort revolved around the user interface for INGRES for Personal Computers. Although the classic INGRES menus with which users were familiar had to be preserved, the design for this product also had to take into account users who have only PC software experience. To improve the usability of the product, two efforts were undertaken.

First, a companion menu structure, similar to the popular "ring menus" of Lotus 1-2-3 and other PC products, was developed. And a new environment variable, called "ii_menu," was assigned to allow the user to choose either the new ring menus or classic INGRES menus for any one session. No reprogramming of any application is required to sup-

port either or both interfaces.

Next, an entirely new set of user documentation was written and designed. Specialists in PC software were employed for this job. The result is an exciting and extremely "readable" configuration of on-screen tutorials, reference material and introductory guides.

From the start, the INGRES for Personal Computers project at Relational Technology was a special effort, challenging the talents of some exceptional people. The end result is a series of programs that will truly change the way PCs are used in organizations now and in the future. Even before its general release, INGRES for Personal Computers captured the imaginations of many people far beyond the engineering team, from end-users to programmers to executives, in the U.S. and abroad.

Steven Vandor, Personal Computer product marketing manager for Relational Technology has eight years of experience in the software industry. He has published several articles in *Byte* magazine and other computer industry journals and has spoken on a wide range of topics at industry trade shows and symposia.

Computer Integrated Manufacturing
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Chrysler Motors
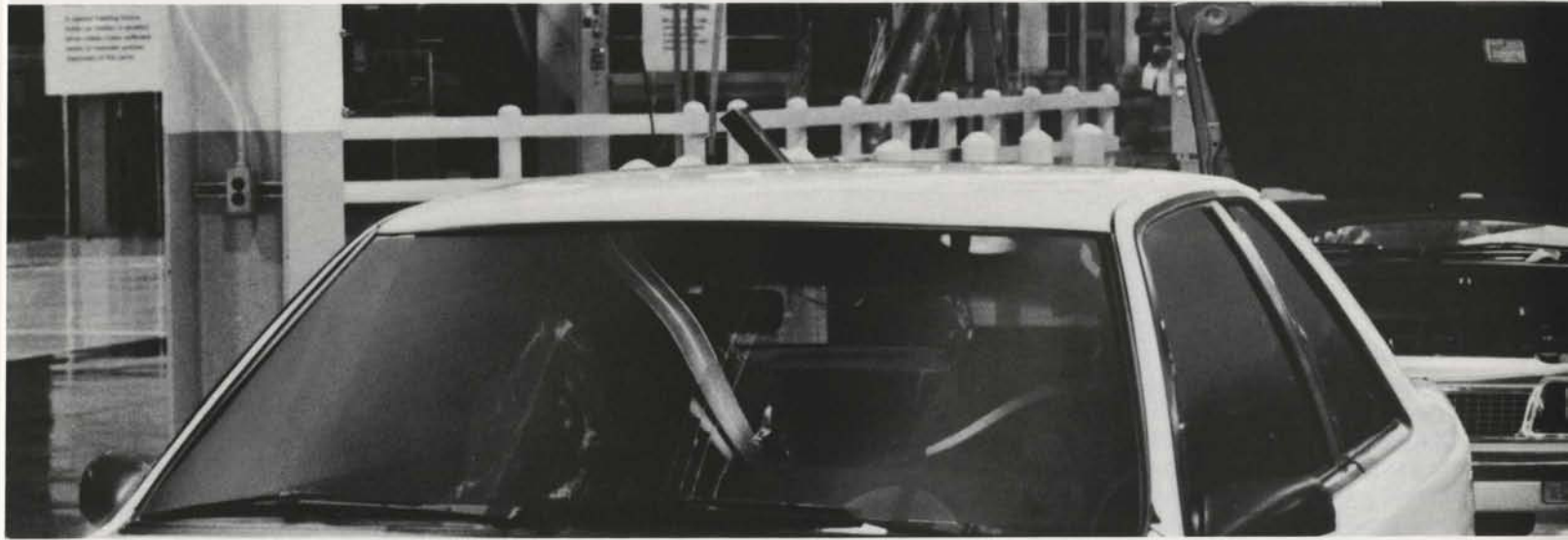
"Our whole objective is to build [an INGRES] database that houses all of the manufacturing data we need...."

Steve Holda
Project Manager for INGRES Systems

Chrysler Motors is the biggest corporate comeback story in American history. Rising from a near bankrupt company in 1979 to the fastest growing automobile manufacturer in America, Chrysler Motors is now regarded as a streamlined, highly well-organized company here to stay.

Much of Chrysler's success can be attributed to the complete overhaul of its manufacturing processes. Plagued by inefficiency and foreign competition, the company was forced to move into a new technological age. And for Chrysler, it worked. In six short years, the company emerged from a failing large car producer into a highly successful full product automotive manufacturer. In fact, under the direction of R.E. Dauch, executive vice president of manufacturing, the company is quickly moving toward a fully automated "Factory of the Future" manufacturing environment.

Today, the Outer Drive Manufacturing Technical Center (ODMTC) at Chrysler is responsible for formulating manufacturing computer solutions. One primary objective of the group is to completely automate the manufacturing pre-production activities, according to Joe Bulat, manager of computer integrated manufacturing,

Once feasibility is determined, the goal of the technical systems staff at ODMTC is to identify what combination of computer technologies can be most effectively used to manufacture the vehicle. These solutions can encompass robotics, Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) and integrated database technology INGRES offers. Robotics are used for machine vision to inspect the quality and construction of the car as well as various welding operations. CAD/CAM equipment is used for three-dimensional design of assembly and stamping tools and helps perform numerical control for the machining of dies. All Chrysler manufacturing plants are serviced by the ODMTC, including five power train (engine/transmission) plants, three stamping plants, nine U.S. and two Canadian assembly plants and five manufacturing plants in Mexico.

"We have seven major INGRES Manufacturing Planning and Control applications in full production," says Steve Holda, project manager for all INGRES applications in the technical systems group at the ODMTC. Among these applications is a press loading and scheduling system which tracks the design, development, construction and assembly of all dies — the "molds" car manufacturers use to stamp out automobile parts like hoods, fenders, doors and frames. "This application tracks the master list of all parts that have to be built or purchased," Holda explains. "It keeps tabs on all of the key elements in a car."

As little as eighteen months ago, all part information had to be painstakingly keypunched by a group of computer operators for batch processing on an IBM machine. When the reports came out, Chrysler planners were forced to wade through rows and rows of binders to find the part number or information they needed.

"You'd have thought it was a public library in here," jokes Bill Kowynia, a twenty-year veteran at Chrysler and a key INGRES user in the Stamping Division's Sourcing and Advanced Planning Group. "It took so much time," he continues, "that you really had to be physically and mentally strong to do your job."

But now that INGRES is on-line, the efficiency of the group has increased tremendously. "We use INGRES for any type of meaningful study we need to do," adds Kowynia. "I can easily get information out of the database to answer questions like: How many hours worth of real time is it going to take to build this car? How many hours will it take to build an L Model like the Omni Horizon at a particular plant? How many presses are running this week and how many dies are at a particular plant? And most importantly, do we have enough time to build this thing according to schedule? In fact, the ODMTC group has emerged as one of the key departments that tracks part information in the company. "At any time, we can tell you what was, what is and what's going to be," adds Kowynia.

Another group at the ODMTC maintains a finan-

cial work order system for estimating the cost of building each part. In addition, a stamping line system maintains manufacturing quality control documents. Informative summary reports are generated with the INGRES Report-Writer for Chrysler executives to study.

"In February," Holda adds, "we launched an MPAC system that automates all of our assembly 'process sheets.' In the future, we'll download the sheets to appropriate assembly plants over the network." The process sheets outline individual processes for each new part operation on an assembly line. "For every model year, we produce 33,000 process sheets containing 12,000 graphic illustrations. Right now there are 131 process engineers who perform this work manually. With INGRES, much of that manual work is eliminated. And the INGRES system works much faster."

Still another INGRES system maintains work order information for parts purchased from several hundred outside vendors.

The Chrysler ODMTC uses INGRES on a VAX Cluster with two VAX-11/780 computers, one VAX-11/785 and a VAX 8650. In addition, the company maintains several MicroVAX computers and multiple IBM PCs. "Currently, we have approximately 170 terminals on our network," explains Holda. "By the end of 1987, we will have expanded that number to 300." The group uses the full spectrum of INGRES products, including Applications-By-Forms and full reporting capabilities. Programs written previously in languages like FORTRAN can also be embedded in new INGRES applications so development time is maximized and old code doesn't have to be abandoned.

In addition, the company is investigating an INGRES/STAR solution for networking all of its assembly plants under a single distributed database. "Our whole objective is to build a database that houses all of the manufacturing data we need so we can train users to do ad hoc reporting of the data through a friendly computer system, wherever they happen to be."

Since the ODMTC began using INGRES in 1984, productivity has improved tremendously. "We've seen at least a 75 percent improvement in developing software," remarks Holda. "With INGRES, major systems are brought on-line in six to nine months instead of the one to three years it might have taken us had we used a third generation language." Augmenting the speed of development, the entire Chrysler manufacturing area has become more aware of the technology that's available to them to increase their productivity. "The awareness of the information is there," concludes Holda. "We're able to produce more at a faster rate and more efficiently."

"In fact," adds Chrysler's Kowynia, "we've become sort of a focal point in the organization because we have the information immediately available. Having that information is enabling us to be very successful."

requiring extensive coordination among the ODMTC, engineering, manufacturing plants and vendors. INGRES, the Distributed SQL Relational Database is playing a major role in that effort.

Engineering has historically been one of Chrysler's strong points. But there was a time when there was little communication between engineering and manufacturing. "I'd call in a guy from engineering, and he'd stand there dumbfounded when I'd explain to him that we had a design problem or some other hitch in the engineering-manufacturing relationship," writes Lee Iacocca in his recent autobiography. "... he might come up with a terrific new design. There was only one problem: he didn't know that the manufacturing people couldn't build it."

Today, the environment is different. Once new products have been identified by Chrysler engineers and automotive designers, the manufacturing center immediately embarks on manufacturing feasibility studies to determine if the new vehicle can be manufactured consistently, and at a quality that enables the company to achieve its goal of the lowest cost producer of cars and trucks — a major thrust of the manufacturing "process-driven design" concept at Chrysler.

A Compu

Carnegie-Mellon Develo

Imagine college students being able to register for courses right in their own dorm room or apartment with a personal computer or terminal, or check on academic progress and converse with an advisor through electronic mail. As a university teacher or administrator, imagine having the opportunity to access the administrative information you need personally, without having to go through the rigor of making those requests through overloaded departmental centers.

All of this and more is one major goal of Carnegie-Mellon University (CMU) in Pittsburgh, thanks to an innovative new technology partnership recently formed between Relational Technology and the university.

The five-year agreement is to create a distributed database environment that will span the university's seven colleges and other administrative departments, ultimately connecting a number of divergent mainframe, mini- and microcomputers in one tightly linked system. A key ingredient to this system is the INGRES/STAR distributed database product from Relational Technology.

A Technology-Driven Environment

In addition to being a learning and knowledge center, CMU has traditionally been a technology-driven environment. Like many universities, it has long cooperated with private industry to develop new technologies and test new products. For example, it was a key beta site for IBM's RT PC engineering workstation and Digital Equipment Corporation's DECNET communications protocol. In addition, CMU was involved in the early exploration of using large disks with personal computers to provide faster ways to transfer data across PC-based networks, as well as the original Apple Computer Consortium.

In 1982, CMU reached a point where the university's computing needs began expanding beyond the limits of its computing power, so it decided to take a serious look at providing the technology to students and faculty directly by means of personal computers and workstations. With this idea in mind, CMU began working with IBM to develop a campus-wide networking system using new fiber optic network technology as well as IBM's Token Ring Network.

The relationship between CMU and IBM sprouted into The Information Technology Center, a $35 million project involving several dozen professors and administrators from CMU and approximately 10 senior specialists from IBM. The center's goal

...er in Every Room

...ping Campus-Wide Applications with INGRES

was to gradually introduce personal computing to the university environment, paving the way for campus-wide use of personal productivity tools and eliminating the use of time-sharing at the university. By November 1986, more than 10,000 connections had been networked to link over 250 separate workstations in 50 sites across the campus. And CMU and IBM jointly announced the availability of "Andrew," a central file storage network and window management system that both faculty and students can use.

Linking Dissimilar Systems

Besides its relationship with IBM, CMU has been involved with testing and developing products manufactured by a number of different computer vendors. At present, CMU is home to 75 DEC VAX 11-780 computers, eight DEC 2060s, between four and five hundred MicroVAXes, an IBM 3083, 1500 or more IBM Personal Computers, greater than 200 IBM RT PCs, over 2000 Macintosh computers and many other manufacturers' products.

"CMU is a very decentralized campus," explains Tony Schaller, manager of administrative systems development at the university. "What we've really got are many separate entrepreneurial organizations each handling their own business."

For example, most universities conduct registration from a central location, like the registrars office. At Carnegie-Mellon, each department maintains its own registration for courses within that school. Data from registration alone can cause a myriad of complex data management problems. Information shared by faculty, administration and students was duplicated across several systems on the campus.

"It was when we started the IBM networking project that we realized we should be looking at a distributed database solution," says Schaller. "We decided to pursue INGRES and INGRES/STAR as a total administrative solution. Another thing that sold us on INGRES," Schaller continues, "was our success with INGRES on our IBM running the VM/CMS operating system."

With the new partnership, Carnegie-Mellon will be developing a central corporate INGRES/STAR database. This INGRES system will act as the database manager for administrative information systems spread across the university. It will also be used for development and control of the overall system. Subsequent development and production systems will be housed on a DEC VAX cluster and two VAX 8700 machines. With INGRES/STAR,

users will be able to access information residing on heterogenous machines as easily as if it were residing on one machine. The user interface remains consistent, enhancing both end-user and programmer productivity.

"Our system development will span the information spectrum," says Len Brush, director of administrative systems. "We will provide core data from the central processor all the way out to where the end-user, represented by a department head, student, advisor, administrator, etc. can have access to appropriate information. At some future point," he continues, "we hope to let individual students tap into the central database and obtain information regarding their course studies and curriculum development."

"This partnership with Relational Technology has generated a lot of excitement at the university," says Schaller. "We will be developing a whole new family of administrative systems for higher education and serving a set of clients that, to this point, have been otherwise unserved."

On Technology's Cutting Edge

"We feel the new partnership with Relational Technology is one of the firsts between industry and higher education designed to place administrative systems on the leading edge of relational technology," says CMU's Brush.

Using INGRES, CMU has already noticed productivity gains in the area of application development.

"We have definitely seen a big gain building applications using the INGRES tools," notes Schaller. "We've seen development time drop from a month to a few days for some systems."

At present, CMU is taking advantage of all of the INGRES tools including the INGRES 4GL and Applications-By-Forms. They also make extensive use of the retrieve and querying capabilities of INGRES.

"I personally feel we will begin to see major cost improvements over time using the new distributed system," concludes Schaller. "The accessibility of information to the end-user and the ability to use the INGRES 4GL will greatly enhance the productivity of the university."

"Relational Technology has their finger on the pulse of industry technology. We feel they are going in the right direction. And we are looking forward to a long-term technological relationship with them."

"We wanted to pursue INGRES and INGRES/STAR as a total administrative solution....Another thing that sold us on INGRES was our success with INGRES on our IBM running the VM/CMS operating system."

Tony Schaller
Manager, Administrative Systems Development

"We feel the new partnership with Relational Technology is one of the firsts between industry and higher education designed to place administrative systems on the leading edge of relational technology...."

Len Brush
Director, Administrative Systems

NEWS

INGRES Wins Best DBMS Software Award For Second Year

For the second year in a row, INGRES was named Best DBMS in the Digital Review 1987 Target Awards. Database users nationwide cited INGRES for its "technological innovation, user friendliness and price/performance."

Digital Review magazine created the Target awards to recognize those products in the DEC market that have had the greatest impact on the DEC industry.

INGRES offers an open architecture distributed database, integrated tools and high-performance SQL–complete data management solutions for today's organization.

INGRES/STAR Gateway to IMS Databases Demonstrated

On December 19, 1986, key staff members of Relational Technology and the research group of one of the country's largest automobile manufacturers demonstrated a new proprietary gateway prototype linking the INGRES/STAR distributed database with an IBM IMS database.

During the demonstration, 20 INGRES/STAR SQL queries were executed—15 which required data extraction from an IMS database and five which required joining information from an INGRES database residing on a DEC VAX computer with information stored in IMS. The operation marked the first case of connecting two foreign databases for retrieving information.

The INGRES/STAR IMS Gateway interface is a nine-month joint development project between the two companies. The demonstration in December represents a significant milestone in its ongoing development. The second phase of the project, intended to provide update capabilities between databases and more efficient retrieval is already underway. Currently, the gateway provides distributed access to IBM's IMS, DB2, SQL/DS and VSAM products. The prototype is also designed to make updates to DB2 and SQL/DS database products. The gateway will not be completed or available until later in the year.

"This is a big step for INGRES/STAR," says Dr. Robert McCord, INGRES/STAR product marketing manager for Relational Technology. "It means the full set of INGRES development tools can now be brought to bear on IBM databases. This greatly increases the functionality of INGRES/STAR."

MVS Development Agreement Signed with Pansophic

As part of a new cooperative development and value-added reseller agreement, Relational Technology will develop and provide an MVS version of INGRES as the underlying database system for a series of future Pansophic products. Pansophic Systems is one of the world's largest independent software vendors.

Under the agreement, Relational Technology will develop versions of INGRES to run on IBM's MVS/XA operating system, under both TSO and CICS. Pansophic will have the right to incorporate versions of INGRES on MVS—and all other operating systems Relational Technology supports—in the entire Pansophic product line.

"We view this as a very strategic alliance through which we can take advantage of each company's technical expertise and market presence," said Eric M. Gnau, director, business development for Relational Technology.

E. James Emerson, vice president of technology for Pansophic said, "Relational Technology leads the industry in relational DBMS technology. We view INGRES as a key strategic element in some future Pansophic products."

Pansophic Systems has been a leading supplier of software since 1969 with over 35,000 product installations covering 8,300 sites. Product lines include on-line application development, retrieval systems, library control, decision support and graphics. Revenues for the fiscal year ending April 30, 1986, were over $84 million, representing a growth rate over the previous year in excess of 20 percent.

Relational Technology Offers Free Special Seminars

Now's your chance to find out more about INGRES for Personal Computers, the fastest relational database system to hit the PC.

Relational Technology is hosting six free special INGRES for PCs events in San Francisco, Los Angeles, Chicago, Boston, New York and Washington DC from March 9-20.

During the seminar, guests will see a live hands-on demonstration of INGRES for PCs and will walk away with a free self-paced tutorial demonstration disk.

INGRES for PCs, tailored for IBM PCs and compatibles, is a functionally complete relational database system identical to INGRES for the mini- and mainframe computer environment. It offers a full-function INGRES database manager which has been engineered to operate efficiently within the personal computer environment and includes a full set of user-interface tools.

Locations and dates for the PC seminars are as follows:

Palo Alto, CA	March 10
Los Angeles, CA	March 11
Chicago, IL	March 12
Washington DC	March 17
Boston, MA	March 18
New York City, NY	March 19

After March, all regularly held INGRES seminars will include information on the INGRES for PCs product.

To register for an INGRES for PCs seminar, call 800-4-INGRES. Space is limited, so call today to guarantee your seat at this event!

INGRES Available for Apollo Workstations

In January, Relational Technology announced the availability of INGRES on the Apollo Computer Inc. Domain/IX operating system. The announcement is part of a three-year, joint-marketing agreement to market and distribute INGRES on Apollo's DOMAIN System product family of high-performance workstations.

Apollo's key technical markets include the computer-aided engineering, design and manufacturing arenas as well as the oil and gas and artificial intelligent (AI) markets, making the joint marketing agreement a perfect match.

"The INGRES environment is particularly well-suited to Apollo's DOMAIN System," said Apollo Senior Marketing Manager Terri McKeever, "because both address the resource-sharing needs of technical professionals who work in a distributed processing environment where data manipulation and analysis are commonplace. INGRES provides DOMAIN system users with the robust, integrated set of tools they require for building complex, multi-user applications in a high-speed resource sharing environment."

"Apollo is recognized as one of the leading suppliers of workstations for technical professionals," said P. Michael Seashols, vice president, sales and marketing at Relational Technology. "We have found many of our Fortune 500 and federal customers have established Apollo workstations as one of their strategic products along with the IBM mainframe, VAX minicomputer and IBM Personal Computer. Since INGRES is available in each of these product-line environments, these customers can now integrate their databases across these heterogeneous hardware systems."

Apollo is the only workstation supplier to offer the two UNIX operating systems most widely used by technical professionals–UNIX System V and Berkeley 4.2. Apollo's DOMAIN/IX product, a twin port of these two industry standards, allows users to run one or both operating systems simultaneously on the same workstation.

The Apollo agreement is the latest in a number of OEM/joint-marketing and development agreements announced by Relational Technology. Other

companies marketing INGRES include AT&T, Data General, Hewlett-Packard, ICL, Pyramid, Sun Microsystems and Unisys.

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New INGRES Book Now Available

C.J. Date, author of A Guide to INGRES.

A Guide to INGRES, authored by database industry luminary Chris Date, is now available from Addison-Wesley publishers.

The book, similar to Date's *A Guide to DB2,* is an excellent source for database and system administrators, systems analysts, application programmers, end-users and end-user management, database consultants and designers, or anyone interested in relational database technology. Date devotes several chapters of discussion to the INGRES "back-end" database engine, "front-end" integrated application tools and INGRES/STAR, the distributed database from Relational Technology.

"I've always been very impressed with the company and the product," said Date. "A great advantage of the INGRES relational database system is that it's really based on sound computer science theory. INGRES is a nice system to describe."

The book is a mix of tutorial and in-depth discussion of the INGRES family of products. Practical exercises are also included throughout the guide. "You can get a pretty good idea from the book of what you can and can't do with the system," notes Date. "And you can try out the exercises if you have an INGRES license."

Siemens Medical Systems Developing Intercontinental INGRES Applications

Using INGRES/STAR, Siemens Medical Systems is planning a strategic intercontinental distributed database linking a complex system of Siemens offices in both the United States and Germany.

In the United States alone, more than 150 sites currently maintaining data on DEC VAX-11/730 and 11/750 computers will be networked into a central INGRES database in Islin, New Jersey. As many as 50 sites in Germany will likewise network into a central computer in Erlangen.

Headquartered in Europe, Siemens Medical Systems is one of the largest producers of medical equipment in the world. Currently the company is working on products in the area of magnetic resonance scanners, a new generation in medical imaging technology.

With INGRES, Siemens is implementing a fully-automated information and service support system for all locations. INGRES will even be coupled with communications technology to automatically dial-up then disconnect to remote and central sites.

"Siemens has a charter to integrate information across all areas of the company," reports Jacob Golder, INGRES project manager for the On-Line Systems Installation and Support group at Siemens. "We will be building all of our other systems products around INGRES."

Current applications planned for INGRES include a common technical library to standardize the company's technical documents, a quality assurance monitoring system to monitor the performance of existing information systems and an expert Computer Aided Instruction system designed to provide on-line training in the use of Siemens equipment.

NEWS

IUA Draws Biggest Crowd

Over 300 people attended the three-day Fall INGRES User Association meeting held last October in Philadelphia, Pennsylvania. A representative from each organization went home with a free early-release version of our recently announced INGRES for Personal Computers product. In addition, users saw a preview of the product, as well as an on-line INGRES/STAR distributed database demonstration. In addition, users had a chance to attend more than 20 user presentations on a variety of subjects as well as a number of Birds-of-a-Feather sessions.

The keynote speaker for the event was Dr. Michael Stonebraker, professor of computer science at the University of California at Berkeley and Relational Technology co-founder. His presentation, entitled "POSTGRES, A Next Generation Database System" described his current research project. POSTGRES is a new DBMS designed to extend use for data types, operators and access methods. According to Stonebraker, it will offer facilities for active databases and simplify crash recovery as well as provide support for complex objects, optical discs and workstations with multiple, tightly coupled processors as well as custom VLSI chips.

The INGRES for PC "Early Release" offering was the highlight of the meeting. Relational Technology Group Product Marketing Manager Ed Forman outlined the company's strategy for the new software: "There are five major areas of use for PCs in the MIS environment," he said. "The integration of PCs in multi-user applications; the deployment of single-user applications; the development of applications for other systems; the connection of PC spreadsheet users to INGRES data; and the provisions of an economical training environment for the user."

In the final count, 210 organizations committed to the use of INGRES were given a complimentary early release product.

Eric Palmer, of Palmer and Associates, is one of over 100 customers who beta tested the product. "The availability of INGRES on personal computers has the potential to change the way micros are used in many applications in diverse industries, and INGRES on the PC will be the best PC database out there," Palmer said.

Among the most liked and attended user presentations were Eric Palmer's talk on "PCs and INGRES: A Developer's Viewpoint" and "Maintaining Productivity Levels After the Fires Have Been Put Out," a presentation by Nestle's MIS Director Richard Porter.

The next IUA meeting will be held in San Francisco at the Sheraton Palace Hotel, April 26-29. Registrations for the meeting can be made by calling 800-4-INGRES.

INGRES users attend the biannual meeting to exchange important information, learn about new products and have fun!

Relational Technology Hosts Second INGRES Advisory Board Meeting

"Connectivity" was the theme of the second meeting of the INGRES Advisory Board, held October 30-31 at the Wyndham Franklin Plaza Hotel in Philadelphia, Pennsylvania. Thirty-one INGRES customers attended the meeting, which proved very productive for both Relational Technology and the key customers who make up the Advisory Board.

The INGRES Advisory Board was formed in April of 1986 in order to provide input to Relational Technology regarding its marketing and product development plans. During the meeting, customers from such organizations as Citibank, Eastman Kodak, General Electric, General Motors, Microsoft Corporation, and Ortho Pharmaceutical Corporation divulged future plans for information connectivity in their respective organizations. A number of executives from Relational Technology discussed future INGRES product plans as well.

"We feel our customer's connectivity plans map very nicely into our future plans for INGRES," reported Relational Technology Director of Product Planning, Aaron Zornes. "Advisory Board members told us that their primary product platforms include IBM's MVS and VM/CMS, DEC VAX/VMS, UNIX and PC DOS operating systems—the five strategic operating systems that, by the end of 1987, we will support."

In addition to plans for connectivity, users discussed their experience with the INGRES/STAR product during the beta testing period. Users were very pleased with the technology and performance of INGRES/STAR. A tremendous amount of enthusiasm was also voiced regarding the new INGRES for PCs product. Users expressed that they are looking forward to the ability to off-load work from their host computer to the PC or workstation.

The next INGRES Advisory Board meeting is scheduled to be held at Relational Technology headquarters in Alameda, California. As the October meeting concluded the one-year term of current Advisory Board members, new members will be nominated prior to the next conference.

Caching in

ÎNGRES

By David Kellogg

With INGRES Release 5.0, INGRES includes further enhancements to "caching" – a mechanism for keeping frequently used data in memory. Caching reduces disk input/output (I/O) and greatly improves overall performance.

Caching of data is used in a variety of software, ranging from operating systems to high-performance relational databases like INGRES. The notion of caching – although perhaps not the name – is a familiar concept.

Consider for example, the student writing an English paper. On the student's desk you would find the reference materials he wishes to use for his paper. He would want his dictionary close at hand while at the same time he would not want a mathematics book taking up valuable desk space.

The student maintains a buffer or "cache" of recently used books on his desk. When he needs to consult a particular book, he first looks to see if the book is already on his desk. If it is, he scores what is commonly called a "cache hit." Data he requested was already in the cache (e.g. on his desk), thereby saving him the effort of getting up, walking to his bookcase, fetching the book and then placing it on his desk.

Continuing with the analogy, the student (or INGRES buffer manager) uses intelligence in choosing which books (or INGRES data pages) he will keep on his desk during the composition of the paper. Certainly, a book which is referenced often – like the dictionary – should have more preference on his desk than an obscure volume which contains one pertinent quote for the paper. Clearly, no chemistry books should be given space on his desk; yet, even among the English books, some books are more important than others. This is the idea of preferential treatment in the cache.

How INGRES Caches Data

Each INGRES user maintains a "local cache" of memory to hold both important and commonly used data. Pages most often found in the "local cache" typically include frequently used data and system catalog pages. The INGRES cache managers are designed as expert systems in themselves – they pay close attention to which types of pages are in the caches, and how many times each page has been resident in the cache before. This – in conjunction with a weighted value scheme and a Least Recently Used (LRU) algorithm – determines which page of the cache will be "kicked out" when a new page needs to come into the cache. Among the highest value pages in the cache are: 1. INGRES system catalog pages; 2. ISAM/B-tree root pages; 3. ISAM/B-tree index pages; and 4. B-tree leaf pages.

Read-Ahead

Another feature of the INGRES caching mechanism is read-ahead. When a user runs a report or executes a query against a sorted structure, like ISAM, the INGRES local cache manager quickly detects that read-ahead will be advantageous and grabs "X" pages per I/O. It gives the user the one page he asked for and loads the other X-1 pages into the local cache. Then, if the next X-1 pages are requested, *no* additional disk I/O is performed; they are already resident in the INGRES local cache. With certain types of queries – called "scans" or "get next" queries – read-ahead can greatly enhance performance.

Read-ahead, like the size of the local cache itself, can be determined by the application developer and built into the application.

On some operating systems, INGRES also implements a global cache that contains data used repeatedly by many users across the entire installation. Pages typically found in the global cache include DBDB catalog pages where information on INGRES users and data-bases is kept, and any data pages that are viewed by many system users. With global caching, small databases can effectively be kept memory resident, thus again dramatically increasing the performance of INGRES. And with large databases, smaller relations may be able to reside entirely in the cache.

With the price of computer memory plummeting, great performance gains can be achieved with INGRES by combining a few new memory boards with the built-in intelligence found in the INGRES local and/or global data caches.

Additional information regarding INGRES caching features can be found in the INGRES QUEL and SQL Reference Manual, INGRES for the VAX/VMS operating system release notes and, for some operating systems, in the Installations and Operations Guide. Techniques for better utilizing the INGRES caches are also covered in the Advanced Performance seminar offered by the Relational Technology training department.

David A. Kellogg, member of the Relational Technology technical staff, regularly provides training, technical support and consulting to INGRES customers.

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INGRES Users Contribute to Quality Through Beta Program

By Meg Verardi

Since the introduction of the first INGRES product in 1980, Relational Technology has strived to ensure the highest technical quality in all new products and releases. To meet this end, INGRES is put through careful design, implementation and quality assurance testing. But after this rigorous cycle, INGRES doesn't meet all the criteria until it's delivered and evaluated by our most critical tester: the customer.

This period of use by selected customers is called the "beta release" phase. The length of the beta period ranges from two to six months, depending on the number, nature and complexity of new product features or enhancements. During this time, users are encouraged to exercise INGRES to the fullest extent possible. Each beta site's applications and utilization of INGRES components and subsystems are tracked in detail by Relational Technology's Beta Support Group. Sites keep the Support Group informed of their time and experience with the product.

To facilitate thorough use of INGRES during this period, users have access to Relational Technology technical support specialists who can answer questions and help isolate problems. The support specialists have direct access to the developers for answering questions, solving problems and making corrections to the new version.

The stability and quality of the new product is evaluated on the number of reported problems relative to the amount of testing. Beta test participants play a key part in determining whether the product is production quality. When the product is deemed ready for production, it is certified for limited release to the customer sites. An additional group of sites is also selected for further exercise. After this period of testing, "final production certification" is awarded to the product, and shipment to our installed base and customers with new licenses can begin.

Our customers are the best judge of INGRES quality, and we value their experience. If your organization is interested in participating in Relational Technology's beta program, please call (415) 769-1400 and ask for Meg Verardi.

Meg Verardi has been with Relational Technology for three years. Previously a technical support manager, Meg now oversees the Relational Technology beta program as beta program manager.

*N*EWS Continued

Strategic Agreements Inked With Data General

In February, Relational Technology and Data General Corporation signed two strategic agreements to offer INGRES on Data General's ECLIPSE/MV family of super minicomputers.

The first — a multimillion dollar joint development agreement between the two companies — will ultimately combine the INGRES integrated application tools with the Data General proprietary DG/SQL database system.

Both companies have committed many man-months to the development of the new product. Technical staff from both Relational Technology and Data General will work on the product over the next two years. The first phase of the product is scheduled to become available in early 1988, with the finished product slated for completion later in the year.

"We felt very strongly that we needed a good 4GL product that Data General could sell and support for our systems," said Barbara Babcock, director of product marketing at Data General. "We view INGRES as one of the top relational database vendors in the industry and we are very proud to make it available on our systems product line. The incremental systems and software sales from this agreement will produce significant revenue for both Data General and Relational Technology."

A second marketing agreement was also signed to offer INGRES on Data General's MV systems running under AOS/VS. In the new agreement, the two vendors will jointly port the full INGRES product set to run under the AOS/VS operating system. The sales force of both companies will be able to market the product.

"Because the INGRES data manager is a very marketable product, we felt that it made sense to port the entire product to the DG AOS operating system," said DG's Babcock. INGRES will be available on this operating system in early 1988.

CALENDAR

INGRES SEMINARS

To learn more about the INGRES Distributed SQL Relational Database System, attend one of the many free INGRES seminars held each month.

The seminars are hosted by an experienced Relational Technology marketing representative who can answer all of your questions and show you why INGRES is the distributed relational solution for you.

The following seminars will be held from now through June. Locations and dates are subject to change, and new seminars are being added every day.

To register for a free seminar call us at (800) 4-INGRES. Space is limited so call today!

AZ	Phoenix	May 27
	Tucson	May 17
CA	Irvine	Mar 3
		Apr 22
	Oakland	Mar 25
		May 13
	San Diego	Mar 10
	San Francisco	Jun 24
	San Jose	Apr 30
CO	Denver	May 14
FL	Melbourne	Mar 24
LA	New Orleans	Jun 10
MA	Burlington	May 28
	Cambridge	Apr 22
	Newton	Mar 26
MI	Detroit	Mar 17
MO	Kansas City	Mar 4
NC	Charlotte	Mar 10
NJ	Iselin	Mar 4
NY	New York City	Mar 25
OH	Cincinnati	Mar 12
	Cleveland	Mar 24
	Columbus	Mar 5
OR	Portland	Apr 28
PA	Pittsburgh	Mar 19
RI	Providence	Mar 11
SC	Columbia	May 26
TN	Memphis	Apr 14
TX	Austin	Apr 8
	Dallas	Mar 12
	Houston	Mar 26
VA	Richmond	May 20
WA	Seattle	May 6

CANADIAN SEMINARS:

ALB	Edmonton	Mar 19
ON	London	Mar 18
	Toronto	May 6
NS	Halifax	Mar 5
QB	Quebec	Mar 24

INGRES TRAINING CLASSES

The following INGRES training classes will be held from now through June. For more information or to register for a training course, call (415) 748-3535. Classes are subject to change.

Each five day INGRES Release 4.0/5.0 course session includes a two-day "Introduction to INGRES for Application Developers" course and a three-day "INGRES for Application Developers" course. Each class may be taken separately.

INTRODUCTION TO INGRES FOR APPLICATION DEVELOPERS

California

January 5-6	(S)
February 2-3	(Q)
March 2-3	(C)
March 9-10	(S)
March 23-24	(Q)
April 6-7	(S)
May 4-5	(Q)
June 8-9	(S)

Maryland

January 12-13	(Q)
February 9-10	(S)
May 11-12	(Q)
June 22-23	(S)

Illinois

January 19-20	(S)
March 2	(Q)
May 18-19	(S)

New Jersey

January 26-27	(Q)
February 23-24	(S)
March 16-17	(Q)
March 30-31	(S)
April 20-21	(S)
June 1-2	(Q)

ADVANCED ABF/4GL SEMINAR

California	April 30-May 1
Maryland	June 16-17

ADVANCED PERFORMANCE SEMINAR

California	April 30-May 1
Maryland	June 16-17

EMBEDDED QUERY LANGUAGE SEMINAR

California	April 30-May 1
Maryland	June 15

(S) VMS and UNIX classes taught in SQL
(Q) VMS and UNIX classes taught in QUEL
(C) VM/CMS classes taught in SQL

SPECIAL INGRES FOR PCs SEMINARS

Palo Alto, CA	Rickey's Hyatt	Mar 10
Los Angeles, CA	Sheraton La Reina	Mar 11
Chicago, IL	Westin Hotel	Mar 12
Washington DC	Crystal City, Hyatt Regency	Mar 17
Boston, MA	Parker House	Mar 18
New York City, New York	St. Regis Sheraton	Mar 19

INGRES FOR APPLICATION DEVELOPERS

January 7-9	(S)
February 4-6	(Q)
March 4-6	(C)
March 11-13	(S)
March 25-27	(Q)
April 8-10	(S)
May 6-8	(Q)
June 10-12	(S)

January 14-16	(Q)
February 11-13	(S)
May 13-15	(Q)
June 24-26	(S)

January 21-23	(S)
March 4-6	(Q)
May 20-22	(S)

January 28-30	(Q)
February 25-27	(S)
March 18-20	(Q)
April 1-3	(S)
April 22-23	(S)
June 3-5	(Q)

INGRES USER ASSOCIATION MEETING

April 26-29 San Francisco, CA Plan to attend the biannual INGRES User Association Meeting April 26-29 at the Sheraton Palace Hotel, San Francisco, CA.

The IUA meeting features three full days of presentations by INGRES users and Relational Technology executives. In addition, new products are regularly previewed to the association.

The IUA Meeting is an important forum for meeting with other INGRES users with similar applications and interests. In addition, it offers you the chance to meet with key Relational Technology management. At this meeting, you'll have even more access to Relational Technology staff as the company headquarters are located directly across the San Francisco bay from where the meeting will be held.

Relational Technology, producers of INGRES, is
known for providing technically superior products in
the relational database market. The company is
committed to distributed solutions which allow users
to access and integrate data across a wide variety
of computers and operating systems including IBM
VM, DEC VAX/VMS and UNIX environments. Since
it was founded in 1981, Relational Technology has
offered four major releases of INGRES, each with
increased functionality and performance. In February,
1987, Relational Technology announced the availa-
bility of INGRES for IBM Personal Computers and
compatible computers.

Relational Technology
1080 Marina Village Parkway
Alameda, CA 94501

(800) 4-INGRES

Relational Databases Gaining Ground On Their More Traditional Elders

By Laura DiDio

LA JOLLA, Calif.—Relational databases are swiftly gaining market share at the expense of older, traditional network and hierarchical database products—with Relational Technology Inc. leading the way, according to a recent survey by Computer Intelligence (CI).

"One indication of just how fast relational databases are coming on is that DEC's DBMS market share has gone from 25 percent in December 1985 to 23 percent in July 1986 and down to 21 percent ... in December 1986," according to the CI analyst who compiled the survey's data.

"However, DEC's relational product offering, Rdb/VMS, went from 10 percent in December 1985 to 14 percent in July 1986 to 15 percent in December 1985," the CI analyst went on. "Because these products balanced out, DEC was able to maintain about a 36 percent combined DBMS and relational DBMS market share."
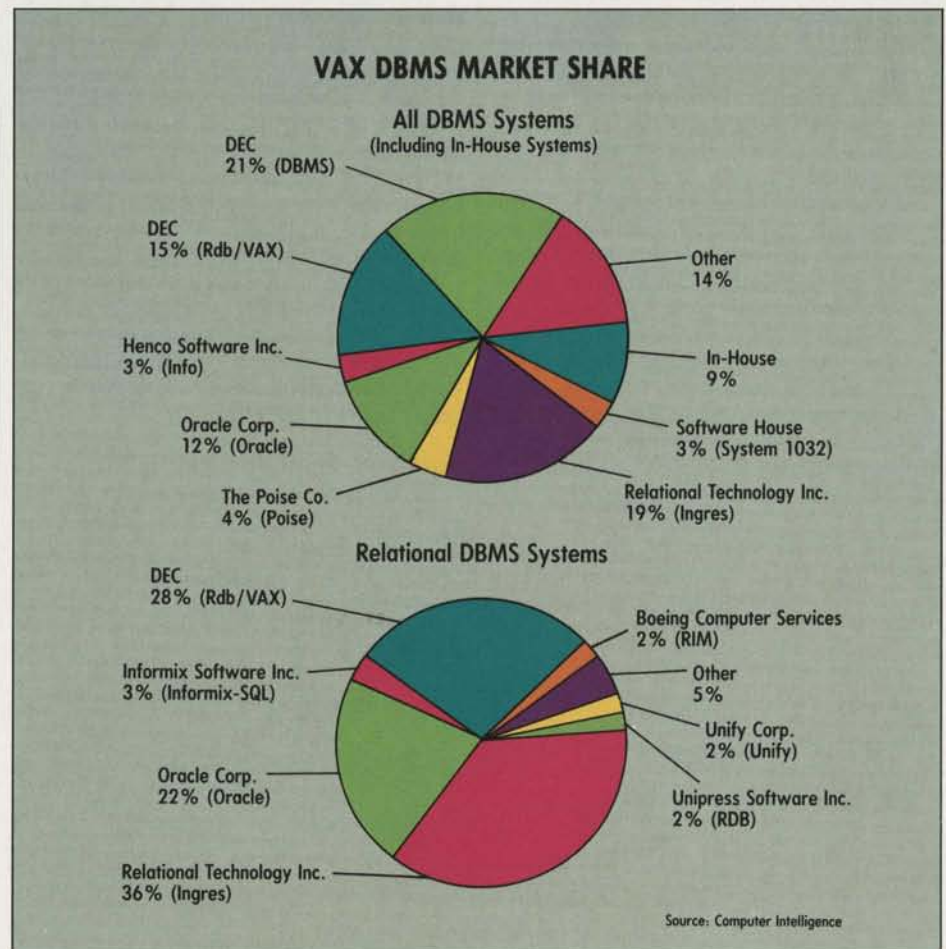
CI's report was based on an analysis of 1,938 VAX sites that had a DBMS installed, while the figures for the relational DBMS market are based on a survey of 1,051 sites, the analyst said.

The CI statistics also showed a downward spiral for DBMS products written inhouse at the sites surveyed. These declined from 15 percent in December 1985 to 9 percent in December 1986.

Growing DBMS Pie

Oracle and Ingres, the other two major players in the overall DBMS market, showed virtually no growth in their respective market shares during the 1985-1986 survey year. "But that fact notwithstanding," the CI analyst insisted, "the overall DBMS market is growing. They're [Oracle and Relational Technology] not getting a bigger slice of the pie, but the pie itself is growing."

CI's figures show that among the sites surveyed, Oracle's market share has remained at a flat 12 percent from December 1985 to December 1986. Ingres, which was in use at 20 percent of the sites surveyed in

VAX DBMS MARKET SHARE

All DBMS Systems
(Including In-House Systems)

- DEC 21% (DBMS)
- DEC 15% (Rdb/VAX)
- Henco Software Inc. 3% (Info)
- Oracle Corp. 12% (Oracle)
- The Poise Co. 4% (Poise)
- Other 14%
- In-House 9%
- Software House 3% (System 1032)
- Relational Technology Inc. 19% (Ingres)

Relational DBMS Systems

- DEC 28% (Rdb/VAX)
- Informix Software Inc. 3% (Informix-SQL)
- Oracle Corp. 22% (Oracle)
- Relational Technology Inc. 36% (Ingres)
- Boeing Computer Services 2% (RIM)
- Other 5%
- Unify Corp. 2% (Unify)
- Unipress Software Inc. 2% (RDB)

Source: Computer Intelligence

December 1985, was down by 1 percentage point to 19 percent last December.

Analysts and users alike agreed that the burgeoning relational DBMS market is the one to watch.

In the relational portion of the market, DEC's Rdb/VMS gained 7 percent in the past year, climbing from 21 percent in December 1985 to 24 percent in July 1986 and on to its current 28 percent market share.

DEC's top two relational rivals—Oracle and Ingres—declined in overall market percentage, although they sold more unit volume of their respective relational software products.

Oracle's market share declined slightly, from 25 percent at the 1,051 sites studied in December 1985 to 21 percent in July 1986 and to 22 percent in December 1986.

Relational Technology's Ingres had a 43 percent market share in December 1985, but this slipped to 38 percent in July 1986 and 36 percent in December 1986.

"Although Ingres has lost market share, it is still the No. 1 relational DBMS product by an 8 percent margin over its closest competitor," the CI analyst noted. "There are two possibilities as to why they're losing

market share: First, DEC is gaining with Rdb/VMS, and also, there are now more relational products on the market then there were a year ago."

The proliferation and popularity of relational DBMS offerings can be explained in three words: ease of use.

Comarco Co., a Sierra Vista, Ariz., government contractor that tests U.S. Army communications equipment, chose Ingres for its flexibility.

"We made our choice three or four years ago and decided early on we wanted a relational DBMS because we were in a tricky development area," observed Pat Kerr, Comarco's senior computer scientist.

"The large development requirements we had weren't well defined, and we realized that a relational DBMS would give us the most flexibility and allow us to make modifications in design as we went along," he explained.

His company chose Relational Technology's Ingres "because of their support for data entry through use of their screen forms, and because DEC didn't have a relational offering at the time," Kerr said.

"We have VAX 11/750s and Micro-VAXes running Ingres," the Comarco scientist said. "The support for data entry through the screen forms lets the application developer design screen forms for accessing the database. We felt this gave us an edge, because we could very quickly devel-op interactive applications. It relieved us of having to design a lot of our own software to perform data validation and screen management."

Another user, the senior staff engineer of a major defense contracting firm whose plant runs Oracle on its VAX systems, offered this opinion. "Relational is not necessarily the most computer-efficient [DBMS] to use from a hardware standpoint. The basic difference between hierarchical and relational [databases] is that the hierarchical structure is laid out already, and this makes it difficult to change."

The engineer, who requested anonymity, added, "For users with a relatively low amount of database knowledge, relational databases are very powerful ones to use. If we made the wrong decisions on what data to input, it's easy to modify, and that far outweighs any hardware disadvantages.

"We're a manufacturing support facility—we don't have all of the data processing tools at our disposal. We're using Oracle running on a VAX 11/785 and 11/750."

Oracle was chosen for its data compatibility with IBM PCs, the engineer said.

But Gig Graham, program director at the Gartner Group Inc. in Stamford, Conn., believes that Ingres and Oracle surpass DEC's Rdb/VMS.

And the Winners Are ...

"From a vendor perspective the winners are Ingres and Oracle because they are the leaders in implementing SQL-based relational architecture on DEC and IBM systems," Graham asserted. "SQL serves precisely the same role for integrating database applications as the Q-bus did for integrating specialized peripheral support," he said.

"Ingres has really come on in the DEC marketplace, although the impression in the market is that Oracle has a larger share," he said.

Graham attributed Ingres' popularity to the fact "that Ingres was developed at the USC Berkeley, the center of Unix development activities, which have since been commercialized by Sun MicroSystems and DEC. And in the VMS world there was a natural desire to have a database that was common to both Ultrix and VMS," he said.

"Ingres promised a level of portability across two DEC operating systems that wasn't initially available from other vendors. In my opinion, the Ingres product strategy of supporting VAX clusters and DECnet will allow them to leverage their overall capabilities more successfully than other players, with the exception of DEC and Oracle," the Gartner Group director maintained.

Graham cited the example of Informix. "It's a very fine product, but it doesn't support DECnet or VAX clusters." ∎

FORTUNE

Relational Technology Inc.

■ Need to pull together information stored in a hodgepodge of incompatible computers? This private company has stolen a march on the competition with software that finally makes it easy for managers to massage data from mainframe, mini-, and personal computers—just as if the information were in one file. For example, 3M uses Relational's system to help pull together all its manufacturing information. Carnegie-Mellon University has bought the software to link computers without regard to race, creed, or color: four Digital Equipment and IBM mainframes, 675 Digital and IBM minis, and 1,500 IBM PCs. In its last fiscal year the Alameda, California, company earned $1.8 million on sales of $28.1 million. C.E.O. Gary Morgenthaler expects profits to hit $4.5 million and revenues to top $50 million this year, when the company is expected to go public. **— Brett Duval Fromson**

# New Systems Tackle Problem
Of Tapping In to Data Bases

By Paul B. Carroll
Staff Reporter of The Wall Street Journal

THERE IS A PROBLEM in using computer data bases. To understand it, imagine a television station assembling a highlights film on Ray Knight, the New York Mets third baseman and World Series star. If the film maker's videotape archives were set up as most computer data bases are, he would be able to pull together his film of all the big plays in Mr. Knight's career in seconds. But to add film stored by the TV networks, he would have to travel to the networks, figure out unfamiliar archiving systems and carry copies of the videotape back with him.

That, roughly, is the difficulty that confronts users of data bases. They can quickly gather information that is stored on their computer, but they face a prohibitively time-consuming process when they try to get information stored on other types of machines.

The problem isn't about to disappear overnight, but the first products that attempt to deal with it are starting to appear. Last month, Oracle Corp. of Belmont, Calif., began shipping what's called a distributed data-base management system. Relational Technology Inc. of Alameda, Calif., promises a similar kind of system by the end of the year, and other vendors, including International Business Machines Corp., will follow.
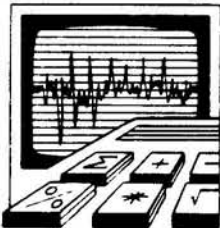
AS WITH MOST new technology, the initial products are limited in scope. Still, these distributed data-base systems at least hold out the hope that, eventually, any user of any type of machine in a network will have easy access to data stored on any other machine in that network, no matter which company made the machine or which operating system it uses.

Currently, to get data from a mainframe with an incompatible operating system, a personal-computer operator generally would have to load a special program into memory, establish contact with the mainframe, make a request in the mainframe's language and write a program to plug the data into the program he wants to run on his PC.

Under a distributed system, a user can request data using the language he's familiar with and receive it in a format he can readily use. "The user doesn't even have to know where the file is that he wants. He just logs on and asks for some information, and the system finds it for him," says Anthony Schaller, manager of systems development at Carnegie-Mellon University, which plans to use the Relational Technology product to integrate 6,000 to 7,000 work stations with its central computer operation.

Distributed products work by, first of all, keeping an index, called a dictionary, that keeps track of the information on all the data bases on all the computers in an organization's network. The data-base management systems also include a device that determines the fastest, cheapest way for retrieving the required information. And the systems do a higher-level translation than network devices can do alone, meaning that information stored under a format used by, say, a Digital Equipment Corp. minicomputer will be usable by, say, an IBM PC.

MINNESOTA MINING & Manufacturing Co., one of the test sites for the Relational Technology product, says the distributed data-base management system is helping it integrate computers it uses in manufacturing. Michael Rohricht, supervisor of the Integrated Computer Systems Group, says 3M will be better able to control inventory and the assembly-line processes because operators, engineers and management will have access to a wealth of information on production problems, results of quality-control tests and the use of raw materials.

"In the past," Mr. Rohricht says, "much of the information was ignored and the benefits of that information were lost."

Oracle and Relational Technology say that almost every large company eventually will need a distributed data-base system because it overcomes the "islands of information" problem. "The current setup doesn't lend itself to saying, 'Oh, what the heck, let me see how many of my sales in the past month have resulted in order backlogs,'" says Ken Cohen, director of product marketing at Oracle. "But now a salesman can know, 'Should I have steel in my voice when I promise that the product can really be delivered on time?'"

THE MAJOR PROBLEM now is that the distributed data-base products only cover a few operating systems, restricting the number of machines they can link. Oracle's SQL*Star product can connect only machines that use an IBM mainframe system called VM, the Digital Equipment VAX language called VMS and the PC/DOS system that runs on IBM-compatible personal computers. Relational Technology says its Ingres/Star will initially be able to handle DEC's VMS system and Unix, a system used largely in the work-station market.

Distributed data-base managers can also seem slow. Although users no longer have to go through a painful series of steps to get information, they may have to wait minutes for the manager to track down and process the data.

Both Oracle and Relational Technology contend distributed data-base systems are the technology for the latter half of the '80s, but their criticisms of each other's current products are telling. Relational Technology says Oracle's product is so slow it should be classed as "vaporware." Oracle says Relational Technology's product covers far too few operating systems. "We feel like we've come out with a family sedan that seats six," Mr. Cohen of Oracle says, "while they've come out with a family sedan that seats one."

Distributed DBMS To Link 3M's Plants Throughout U.S.

By PATRICIA ZENGERLE

ST. PAUL, Minn.—Distributed database management systems (DBMSs) mark one of the hottest—and most questionable—provinces in the large systems software arena, but at least one major U.S. industrial company hopes to use one to create a database linking its manufacturing plants across the U.S.

Minnesota Mining and Manufacturing (3M), the industrial and consumer products corporation based here, has for the past five years been planning and developing a Process Management and Quality System (PMAQS), a multicomputer software system intended to manage data for its geographically disparate facilities.

For the past one-and-a-half years, the company's engineering systems and technology group has been working in its laboratory to develop a prototype on Digital Equipment Corp. VAX processors of the distributed DBMS it hopes eventually will act as a single manager for 3M's manufacturing data, including linking it to its corporate data centers.

Within the next few years, 3M hopes to begin expansion of PMAQS, installing the distributed DBMS in its manufacturing plants and expanding it to tie together data stored on equipment manufactured by different vendors.

They may include Hewlett-Packard Corp., International Business Machines Corp., Sun Microsystems Inc. and manufacturers of personal computers running Microsoft Corp.'s MS-DOS operating system.

Based On RTI's Ingres Star

Victoria Winters, advanced systems engineer with the engineering and technology group, said the laboratory system is based on Ingres Star, a distributed relational DBMS from Relational Technology Inc. (RTI), Alameda, Calif., and Quel, RTI's query language, although she added that 3M is migrating to SQL, the International Business Machines Corp. query language.

The distributed database is stored on the group's development system, which consists of two VAX 11/780s and one Micro-VAX 725 connected via a DECnet, an Ethernet-based local area network (LAN), tied to between 60 and 80 terminals with a total of "a couple hundred" users, Winters said, although it is used by no more than about 30 people at a time.

The main database, stored on one of the 780s, contains around 400,000 blocks of information and is growing daily. Within the distributed configuration, databases of about 20,000 to 30,000 blocks of information are stored on the other processors in the system.

"Those processors simulate the distributed users," Winters said. "That information is also used to update the main database, as needed."

"One of the really nice things is that you can define a distributed database with as much information as you need," she said. "Users don't need to know about data that might be extraneous to them. That is dynamic, you can change that at any time, by redefining an individual database to include new information. You don't have to worry about where the information physically resides."

Other Applications Shaped

The development system is used for applications besides the PMAQS system. "Typically we have five or six applications being developed at the same time," she said. "Our system is also used for day-to-day office automation."

Michael Rohricht, integrated computer systems development supervisor with the engineering and technology group, said the five programmers developing applications for PMAQS are using the Ingres Star system to simulate manufacturing applications in a distributed environment, collecting production, process and quality data on one of the corporation's consumer products and integrating it into an inventory control system.

The integrated data is then used to create a single source for information on the raw materials being used to manufacture the consumer product.

"We would retrieve information from multiple databases and replace the information, and update it into two different databases," Winters said.

She added, "Our application is a real-time application in which we have real-time operators accessing information, making real-time updates and rigorously using the Ingres product. What we try to do in the lab is develop software systems for manufacturing. . .we actually simulate a manufacturing application within the lab, using real-plant data."

The staff developing PMAQS also plans to address issues including the speed of the system, its processing capacity and other problems of managing a distributed environment, including recovering the system in case it crashes.

"We haven't run into problems with speed on the Ingres Star product yet," Winters said. "We currently spend our time partitioning our distributed environment. Once that is done we will be concentrating on performance checks. Speed is one of our top priorities."

As to the future of the system, Rohricht said, "In the next few years, we are looking more at integration within a manufacturing plant, applying distributed technology to manufacturing within a plant or a couple of plants. We intend to upgrade existing manufacturing applications to a distributed environment."

In the longer term, the company hopes to install Ingres Star as a manager for data related to its manufacturing operations, including information stored in corporate, and other databases, Winters said, although she said all of the necessary links to other vendors' systems are not yet available from RTI.

Rohricht added, "We see the distributed product also going beyond the plant environment. . .there is a need within our manufacturing operations to know manufacturing information from within other operations."

Winters said that 3M's investment in PMAQS will run to millions of dollars by the time Ingres Star is installed and linking 3M's manufacturing plants, and relevant corporate computer systems. To date, she estimated that the company has invested "around $2 million."

INGRES FOR PCs
A Benchmark Comparison

In February 1987, a benchmark comparing INGRES, Oracle and Informix SQL relational database management systems for Personal Computers was conducted by Eric Palmer & Associates, Duluth, Ga.

"Of 110 query results INGRES was the clear leader in performance," the benchmark states. "Eighty seven first place finishes went to INGRES and three ties for first place went to Informix and INGRES."

First Place Finishes

Informix 15.9%

Oracle 4.4%

Ingres 79.6%

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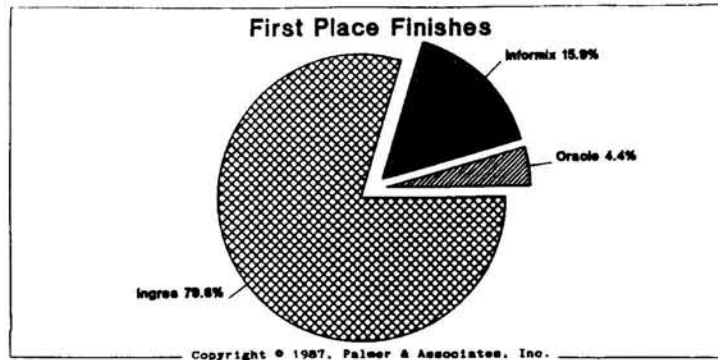
The Palmer benchmark summarizes:

"INGRES clearly performed better than Informix and Oracle on 87 of 110 queries and tied with Informix on three others . . . INGRES took second place for 18 of the remaining tests and third place on only two."

"INGRES performed better than the other two products on all of the set function queries . . . where INGRES performed better than the other two products, it generally did so very significantly."

"Oracle could not compete with the other two products and was clearly outdistanced . . . Oracle performed so poorly that we would not consider using it at this time for development projects."

INGRES VS ORACLE: BENCHMARKS ON IBM PC AT

Relative Execution Time

SELECT   JOIN   SET FUNCTION   UPDATE QUERIES

INGRES   ORACLE(best)   ORACLE(worst)

Source: Palmer and Associates, Inc.
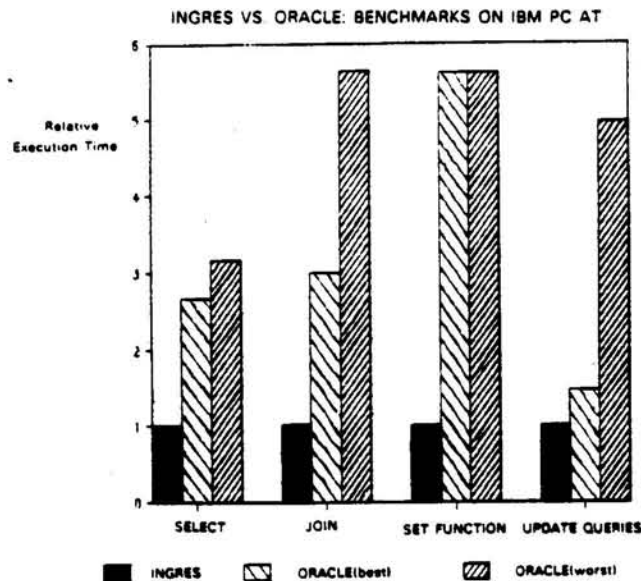
For a complete copy of the Palmer benchmark results, call 800-4-INGRES.

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         415-769-1400   408-496-6511

FOR IMMEDIATE RELEASE
(MPR-049T-001)

RELATIONAL TECHNOLOGY BRINGS INGRES TO PCs,

INTEGRATING THEM WITH CORPORATE COMPUTING POWER

Software Can Help Solve
Data Management Problems

ALAMEDA, California, February 17, 1987 -- Relational

Technology Inc. today introduced INGRES for Personal Computers, a

new generation of PC relational database software. It allows

users to get full use of mainframe database management system

(DBMS) capabilities on the PC and integrate PCs into the

corporate computing environment.

With INGRES for PCs, all the performance, power and

functionality of INGRES on minis and mainframes is now available

for PCs used in both stand-alone and networked systems. INGRES

is the leading relational DBMS (RDBMS) in the DEC VAX world, with

a greater than 40% RDBMS market share. (According to the 1986

Computer Intelligence Corp. study.)

-- more --

INGRES for PCs will be used within the corporate computing environment four ways:

- In a <u>distributed configuration</u>, to run applications on PCs which process data residing on minicomputers and mainframes;

- As a <u>stand-alone PC database system</u> providing superior performance and functionality for powerful PC applications;

- As a <u>full function 4GL application development environment</u> where applications can be developed on PCs for use on mainframes and minicomputers;

- As a <u>bridge</u> between the PC and mini/mainframe database systems, enabling the PC user to access INGRES data and use it with popular PC software such as Lotus 1-2-3.

"For the first time, the PC is fully integrated into the corporate computing environment, not treated as an independent system," said P. Michael Seashols, vice president, sales and marketing. "It becomes part of a distributed information system, not just an island of information."

The software has been beta tested and evaluated by more than 500 organizations, including Chrysler Corporation, Citibank, Eastman Kodak, General Electric and Upjohn.

<u>Distributed Data Management</u>

INGRES now brings PCs into the INGRES/STAR distributed database environment. PC users can transparently retrieve and update data on minicomputers and mainframes as easily as if data were on their own PC. Users can access data simultaneously from multiple mainframes and minicomputers. In addition, multiple PC users can share a single concurrent mini/mainframe database.

INGRES queries and applications look exactly the same to the end user whether the data is local or remote. Host databases are not downloaded to the PC. Rather, INGRES converts the PC user's request into SQL that is processed by the host. Results are returned from the host to the PC. The PC user does not have to know host location or retrieval methods.

Superior Performance

INGRES is also a powerful standalone PC database system. It performs sophisticated applications that used to require mainframe or minicomputer power and functionality.

Performance benchmarks from Eric Palmer & Associates and University of Stuttgart show INGRES to be the fastest DBMS currently available for sophisticated PC applications.

This capability allows the information manager to offload single user applications from the mini and mainframe environments to the more economical PC. In addition, the PC can be used as a low-cost INGRES training environment.

Full Function Environment

INGRES for Personal Computers is also a powerful application development environment. INGRES's Visual Programming, 4GL and Embedded SQL application development tools have been ported to the PC.

Applications that will be run on a mainframe or minicomputer can be prototyped, developed and tested on the PC, then moved directly to the production environment without change.

Bridge to Productivity Tools

INGRES for PCs can easily and cleanly access and reformat data for use with popular productivity tools such as Lotus 1-2-3, Multiplan, dBASE II/III, WordPerfect or WordStar. INGRES/PCLINK provides a smooth software-to-software link that makes it simple for PC productivity tool users to access and manipulate corporate data.

Users familiar with Lotus 1-2-3 will recognize the same function-key usage and screen design. This makes working with INGRES for PCs easier, especially for new users.

"INGRES for PCs is more than just another data manager for PCs," said Seashols. "It is the first general purpose software for developing PC applications in a distributed environment. It increases the performance and application-writing power of the PC and makes it easier to use standard productivity tools. It is a new way to use PCs to solve difficult data management problems."

Operation Requirements

The software fully implements the SQL database language and is compatible with IBM DB2, ANSI and X-OPEN-SQL. It allows complete data and application portability between the PC and DEC VAX/VMS, UNIX and IBM mainframe operating systems. INGRES for PCs requires an IBM PC/XT, PC/AT or 100% compatible system.

The product comes with complete technical documentation--which has been specially written for a PC audience--and computer assisted instruction.

Users can opt to purchase hot line telephone support and classroom or custom on-site training, similar to the support provided for mini and mainframe products.

-- more --

Price and Delivery

INGRES for PCs includes six product modules that may be purchased individually or together, depending on customer application. A typical configuration can cost from $1200 for a stand-alone base system to $2000 for a complete application development system.

Delivery is scheduled for March 1987.

Relational Technology is a leading developer of relational database management systems and a pioneer in advanced distributed database solutions. The company's primary product is INGRES, the Distributed SQL Relational Database System. INGRES combines an open-architecture distributed database capability with integrated 4th generation application tools and a high-performance SQL database.

INGRES is currently available across a wide range of operating environments including IBM mainframes and compatibles with VM/CMS or UTS; DEC VAX minicomputers with VMS and Ultrix; workstations such as Sun and Apollo; and more than a dozen other UNIX operating system-based computers.

For more information, call Relational Technology at (800)4-INGRES, or write to Relational Technology Inc., 1080 Marina Village Parkway, Alameda, CA 94501-9891

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IBM, IBM PC, PC/AT, PC/XT and DB2 are trademarks of International Business Machines Corporation. Lotus 1-2-3 is a trademark of Lotus Corp.; Multiplan is a trademark of MicroSoft; UNIX is a trademark of AT&T; dBase is a trademark of Ashton-Tate; DEC, VAX, VMS, Ultrix and WordPerfect are trademarks of Digital Equipment Corp.; WordStar is a trademark of Micropro.

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FOR IMMEDIATE RELEASE
(MPR-047L-001)

RELATIONAL TECHNOLOGY LINKS UNIX, VAX/VMS, AND PC-DOS SYSTEMS IN DISTRIBUTED DATABASE DEMONSTRATION

Washington, D.C., Jan. 21, 1987 --Representing a first for the relational database industry, Relational Technology, makers of the INGRES Distributed SQL Relational Database Management System, today demonstrated INGRES's ability to link database systems operating under UNIX, VAX/VMS and PC-DOS.

Relational Technology's demonstration, held at UniForum, showed INGRES's ability to join, retrieve and update data from a number of computers and operating systems located at five vendors' booths. Participating were Relational Technology Inc., Digital Equipment Corp. (DEC), Pyramid Technology Corp., Sequent Computer Systems, and Sun Microsystems Inc.

Computers and operating systems in the distributed database network included:

Vendor	Computer	Operating System
* Relational Technology (Booth #1560)	MicroVax II Pyramid Workcenter IBM PC AT	VAX/VMS OSX 3.1 MS-DOS
* DEC (Booth #1830)	VAX	Ultrix 2.0
* Pyramid (Booth #1940)	Pyramid Workcenter	OSX 3.1
* Sequent (Booth #1140)	Sequent Balance	Dynix 2.1
* Sun (Booth #1712)	Sun3	Sun 3.2

--more--

The step-by-step demonstration highlighted the ability of the company's distributed database product, INGRES/STAR, to access data on multiple computers simultaneously, as if all information was resident on a single computer.

"The benefits of linking information from databases residing on different computers and running under different operating systems greatly enhances an organization's production and performance," said P. Michael Seashols, Relational Technology vice president, sales and marketing. "UNIX operating system-based computers can now share data among themselves or link to databases located on divergent hardware, like a DEC MicroVAX, running under the VMS operating system."

The database application for the demonstration was designed around a restaurant's wine database. An end-user, or "sommelier," could access the database via an IBM PC to request the type and year of wine best suited for a particular meal. Menu selection was located on a MicroVAX at Relational Technology's booth while french white wine data, for example, was located on a Pyramid Workcenter at Pyramid's booth. Data for different types of wines resided at other locations.

INGRES/STAR's distributed "query optimizer" minimized data movement for optimal throughput in the distributed environment as it went about the business of retrieving data and accessing information about the wines from various systems. Within seconds of a request, the end-user was provided with the wine, or list of wines, best suited for the accompanying "main course."

Relational Technology is a leading developer of relational database management systems and a pioneer in advanced distributed database solutions. The company's primary product is INGRES, The Distributed SQL Relational Database System. INGRES combines an open architecture distributed database capability with integrated application tools and a high-performance SQL database. INGRES application tools include a fourth generation application development environment and end-user decision support tools.

INGRES is currently available for a number of operating environments including IBM mainframes and compatibles with VM/CMS or UTS; DEC VAX super minicomputers with VMS, Ultrix and UNIX; and more than two dozen other UNIX operating system-based computers including SUN, Apollo, AT&T, Hewlett-Packard, and NCR. For more information on INGRES call Relational Technology at 800-4-INGRES, or write to Relational Technology Inc., 1080 Marina Village Parkway, Alameda, CA 94501-9891.

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RELATIONAL TECHNOLOGY AND CARNEGIE MELLON

SIGN TECHNOLOGY PARTNERSHIP AGREEMENT

INGRES/STAR the Center of Campus-Wide
Distributed Relational Database System

ALAMEDA, Calif., November 10 -- Relational Technology and Carnegie
Mellon University (CMU), Pittsburgh, Penn., have announced a five-year
technology partnership agreement to create a distributed database environment
that will span the university's seven colleges. This agreement marks the
first non-governmental pact to develop integrated information systems based on
a distributed database environment that includes a variety of mainframes,
minicomputers and personal workstations.

The implementation of this distributed database environment will
provide end-users access to multiple databases residing on divergent hardware
and operating systems. CMU users in one department can develop applications
and access necessary data and records from remote departments. Key to the
operation is INGRES/STAR, Relational Technology's heterogeneous distributed
database product which runs on a wide range of hardware and operating system
configurations.

At present, the CMU computing environment includes 75 DEC VAX 780's,
eight DEC 2060's, 400 Micro VAX'es, 1500 IBM PCs, more than 200 IBM RT's and
2000 Apple Macintoshes. It's administrative production systems, for example,
reside on both a DEC 2060, a VAX 780 and a 3COM Etherseries LAN.

- more -

A major development effort is underway to integrate University information within an Ingres database on an IBM 3083. Future plans include developing a new student information system, an alumni/development system and a human resources information system. These will reside on a VAX cluster and two 8700's.

"Under the new partnership, we plan to use the INGRES/STAR distributed database, along with Relational Technology's personal computer product currently being beta-tested at CMU, to distribute computing power across the university, moving data from a central system to departmental systems and ultimately to individual personal systems," said Tony Schaller, CMU manager of systems development for administrative systems.

CMU is a pioneer in the commercial use of distributed relational database management. The university will publicly demonstrate INGRES/STAR at the Educom Conference, November 11 - 14 in Pittsburgh. The university is also a beta site for Relational Technology's new Ingres for the Personal Computer product.

According to Len Brush, CMU director of administrative systems, "with INGRES/STAR, we will be developing a whole new family of information systems for higher education."

INGRES/STAR allows transparent access across a variety of environments from mainframes to mini- and microcomputers. Distributed database technology transcends existing database management and database networking technologies. It presents an organization with a single relational view of all data stored within an entire network of computers so users need not be concerned with where data is located, how to get it, or what type of hardware or operating system is used.

- more -

Relational Technology is a leading developer of relational database management systems and a pioneer in advanced distributed database solutions. The company's primary product is INGRES, the Distributed SQL Relational Database System. INGRES combines an open architecture distributed database capability with integrated fourth generation application tools and a high-performance SQL database.

Relational Technology's INGRES dominates the DEC VAX marketplace with 45 percent market share. INGRES is currently available for a number of operating environments including DEC VAX/VMS, IBM mainframes and compatibles with VM/CMS or UTS, and more than two dozen UNIX operating system based computers. For more information on INGRES call Relational Technology at 800-4-INGRES, or write to Relational Technology Inc., 1080 Marina Village Parkway, Alameda, CA 94501-9891.

RELATIONAL TECHNOLOGY INC.

CORPORATE BACKGROUNDER

FEBRUARY 1987

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(MPR-029C-001)

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OVERVIEW

Relational database management systems offer today's computer user an easy-to-use, time saving program for storing, retrieving, accessing and updating information. The relational model was developed by Dr. E.F. Codd at the IBM research center in San Jose, Calif., to fill the need for a simple, well-defined database system. With it, technical professionals and end-users can view large blocks of data organized in the form of simple tables without needing to know how the database works. Today, virtually all new database management system products are relational. Analysts view relational technology as the major driver of the database industry in the years to come.

THE COMPANY

Relational Technology Inc. is a leading supplier of relational database management systems. The company was one of the first to be solely devoted to the relational database marketplace. Company founders and management are among the most experienced in the industry.

Relational Technology is known for providing technically superior products and is committed to distributed solutions which allow a user to access and integrate data across a wide variety of computers and operating systems. In addition to its technical leadership, Relational Technology has earned a reputation for superior customer service and support.

Relational Technology's primary product is **INGRES, The Distributed SQL Relational Database System.** In addition to its database system, INGRES provides integrated tools including a fourth generation application development environment and end-user decision support tools. INGRES currently runs on a variety of mainframe, minicomputer and microcomputer systems.

Relational Technology also markets **INGRES/STAR**, the world's first commercial, heterogeneous distributed database system. INGRES/STAR enables organizations to develop applications and process data that span a variety of computer systems, with the same ease as if all information were resident on a single computer.

Seven of the top ten United States industrial companies are Relational Technology customers. They are: Chevron, DuPont, Exxon, Ford, General Electric, General Motors, and IBM. In addition, INGRES is used by 22 of the top 29 MIS installations in the country, as ranked by InformationWEEK magazine on October 6, 1986.

INGRES is the leading relational database system on DEC VAX systems. According to a 1986 survey by Computer Intelligence Corporation, INGRES holds a 45 percent market share, followed by DEC's Rdb with 30 percent and Oracle with 25 percent. For the second year in a row, readers of Digital Review magazine voted INGRES the "Best Database/Fourth Generation Language Software Product" in the DEC marketplace.

INGRES is used for a variety of corporate, institutional and government applications including banking and finance, research, engineering and manufacturing (including CAD/CAE/CIM). Applications range from monitoring coin box capacity in pay telephones and tracking patient records at medical facilities, to managing a new automobile plant and controlling the design and production of software in an international modular telecommunications switching system.

Relational Technology traces its beginnings to the INGRES research project at the University of California at Berkeley in the early 1970s. There, company founders Lawrence Rowe, Michael Stonebraker and Eugene Wong pioneered the development of a relational database system, during the same time that Codd's work was evolving at IBM.

The INGRES research group was a pioneer in the integration of relational database systems and application development tools, and in the development of distributed database systems.

A prototype of INGRES was available in early 1975. Later that year, over 150 sites were using the product. Users found INGRES to be very easy to use after a minimum amount of training. Because less training was required, the start up cost for INGRES was significantly lower than for previous systems.

As INGRES's popularity grew, demand from users for additional support and functionality was too great for a research project to handle. Relational Technology was incorporated in 1980 by Rowe, Stonebraker, Wong, Gary Morgenthaler and a recruit from Cullinet Software. Previously a general business consultant from McKinsey & Company, Inc., Morgenthaler joined Relational Technology as executive vice president and chief operating officer. He was promoted to president in 1984, and is currently chairman and chief executive officer. Initial funding was provided by Sutter Hill Ventures and the five founders.

The privately-owned company has grown rapidly, from revenues of $0.9 million in fiscal year 1982 to $28.1 million in fiscal year 1986, and anticipates rapid growth through 1990 and beyond. (Relational Technology's fiscal year ends June 30.) The company has been profitable for each of the past five years.

Relational Technology currently employs over 300 people worldwide. In 1985, the company moved its headquarters from Berkeley to an 88,000 sq. ft. facility in Alameda, Calif. The company has 20 regional sales and service centers throughout North America. International operations consist of a headquarters office in London, and sales offices in Paris, Berlin, Amsterdam, and Sydney. INGRES is further marketed through distributors in Belgium, Finland, Hong Kong, Ireland, Israel, Italy, Norway and Sweden.

Relational Technology has been the first to market with many technical innovations. The company's list of industry firsts includes:

* the first to introduce visual programming approaches to interfacing with a relational database (1981)

* the first integration of graphics with a relational database system (1983)

* the first database networking product for distributed access (1983)

* the first integration of fourth generation language application development tools with a relational database (1984)

* first to introduce an integrated micro-to-mainframe link with a relational database (1985)

* the first heterogeneous distributed database management system (1986)

MARKET BACKGROUND

The Evolution of Database Management Systems

Database management is one of the most important functions provided by modern computer systems. Often, it is the principal justification for acquiring a computer. A database is a computerized record keeping system. Organizations use a database to collect and organize information. Database management implies a systematic way to store and catalog records in the computer that allows easy retrieval of information on demand and the ability to update records when necessary. The data can be shared by several applications and should be easily accessed from all application perspectives.

Prior to the development of the relational approach, the relationship between different parts of the database had to be rigidly defined when the database was created. Database systems were difficult to understand, and people with highly specialized skills were required to develop applications to extract and update data. There was little support for direct end-user access. Installation and implementation was a slow and difficult process.

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Dr. E.F. Codd's relational model described the capability to efficiently access and manipulate data, regardless of the manner in which the data is physically stored. In the rush to become "relational," many vendors claimed to offer relational-like products that do not comply with Codd's model. By simply overlaying some relational features over a hierarchical or network database, certain products have been made to look relational. These "born again" relational database management systems do not provide the benefits of a true relational system in terms of flexibility, ad hoc capability, ease-of-use by non-technical users and the ability to support true distributed databases.

Relational Technology's Market

The worldwide market for mainframe and minicomputer database management systems, according to InfoCorp, a Cupertino, Calif.-based research group, was $4.4 billion in 1986. This was up from $4.0 billion in 1985. The market is rapidly moving to relational technology, which is expected to be the dominant approach by 1990. The market is also interested in solutions that are common across the major micro-, mini- and mainframe computer systems and that adhere to SQL standards. In addition, the technology responsible for an emerging "distributed database" market represents a major innovation that resolves the significant problem of corporate data being dispersed across a number of normally incompatible environments.

Relational Technology is an acknowledged leader in the distributed, relational DBMS market and INGRES is the leading relational DBMS in the DEC VAX world with a greater than 40 percent market share (according to a 1986 Computer Intelligence Corp. study.)

Relational Technology has played on its strengths in the minicomputer market to enter the mainframe and microcomputer markets. INGRES is currently available across a wide range of operating environments including IBM mainframes and compatibles with VM/CMS or UTS; DEC VAX minicomputers with VMS, Ultrix and UNIX; workstations such as Sun and Apollo; IBM PCs and compatibles with MS-DOS; and more than two dozen other UNIX operating system based computers.

The current INGRES Release 5.0 supports INGRES/STAR's ability to access remote INGRES databases from an INGRES application, regardless of the remote operating system. It has an extended SQL query language that is broadly compatible with IBM's DB2. Its ease-of-use, functionality and increased performance extends INGRES's accessibility to more users. INGRES performance has improved by over a factor of ten since it was first introduced in 1980.

Many environments require a highly flexible, highly functional product where programmers and professionals can query the database in a "what if" format. The INGRES relational database languages and fill-in-the-forms tools are ideally suited to these applications. Relational Technology plans to continue its leadership role in this arena through leading edge product enhancements and further integration of application development tools.

In addition, Relational Technology is committed to high performance solutions to address transaction oriented applications. Relational Technology believes that there is no fundamental reason why relational systems, such as INGRES, can't perform as well or better than traditional approaches.

SALES AND CUSTOMER SUPPORT

Relational Technology sells its products directly to major corporations and government accounts through North American sales and field support offices in Atlanta, Boston, Chicago, Dallas, Denver, Detroit, Houston, Los Angeles (2), Minneapolis, New York (3), Pittsburgh, San Jose, Seattle, Washington D.C., Toronto and Montreal. Corporate headquarters are in Alameda, Calif. In addition to its international headquarters in London, and sales offices in Paris, Berlin, Amsterdam and Sydney, the company has distributors in Belgium, Finland, Hong Kong, Ireland, Israel, Italy, Norway and Sweden.

Relational Technology has OEM or joint marketing agreements with many computer system manufacturers to sell INGRES on their hardware. These hardware vendors include AT&T, Alliant, Amdahl, Apollo, Burroughs, Computer Consoles, ComputerVision, Data General, ELXSI, Gould, Hewlett Packard, International Computers, Ltd., (ICL), NCR, Pyramid Technology, Sequent, Sequoia Systems and SUN Microsystems. In addition, the company has VAR agreements with several independent software vendors which manufacture products for a wide range of industries including government, defense, banking and finance, CAD/CAM/CIM and CAE/CAD.

Relational Technology is committed to providing a high level of customer support. A recent Datapro report states "Relational Technology has earned a reputation for providing excellent customer support and for developing and continually enhancing a reliable product." Services include: customer training, on-site consulting, unlimited telephone support, a 24-hour, 7-day a week emergency hotline and a dial-in customer information service.

THE PRODUCTS

Relational Technology's principal product is **INGRES The Distributed SQL Relational Database System.** INGRES is an integrated product that includes several components.

At the core is a high-performance SQL-based relational database management system. Application tools are closely integrated with the relational database system and include a fourth generation application development environment and end-user decision support tools. INGRES is designed to operate in a distributed environment, and facilities are provided for both networking and true distributed database.

Today INGRES has been selected for a range of applications because of its high functionality, reliability and performance. For example, Nestle Enterprises Canada Limited, has more than doubled productivity in its MIS department over the past two years with INGRES, and has now selected INGRES as its complete database engine throughout the corporation.

At Carnegie Mellon University (CMU) in Pittsburgh, Pa., INGRES is the center of a distributed database environment that will span the university's seven colleges. The application is the first non-governmental pact to develop integrated information systems based on a distributed database environment that includes a variety on mainframes, minicomputers and personal workstations. The implementation of this distributed database environment will provide end-users access to multiple databases residing on divergent hardware and operating systems.

Minnesota Mining and Manufacturing (3M) is developing a distributed database system based on INGRES/STAR which will act as the single manager for 3M's manufacturing data including linking it to corporate data centers. In addition, the INGRES/STAR system will be used to simulate manufacturing applications in a distributed environment -- collecting production, process

and quality data on one of the company's consumer products -- and integrating it into an inventory control system.

INGRES is also the basis for an entire Computer-aided Design (CAD) and Drafting system for architectural projects at Helmuth, Obata and Kassabaum, where it assists in three-dimensional architectural design, space and inventory planning and resource management.

At General Electric's aircraft engine plant, INGRES is used for Computer Integrated Manufacturing (CIM) where it tracks all manufacturing processes including production control, process information, engineering, accounting and inventory of aircraft engine turning parts. At Atlantic Richfield Coal Company, INGRES -- running on an IBM mainframe -- performs ad hoc queries and produces reports of geological data for coal deposits in Colorado, Wyoming and Australia.

Open Architecture Distributed Database

Relational Technology is a pioneer in the development of distributed solutions. Relational Technology is committed to expanding distributed solutions because the company believes that the trend in computing environments is toward being both heterogeneous and distributed. The company's founders have been involved in the research and development of distributed solutions for the past four years. Relational Technology introduced the first database networking product in 1983 and the first heterogeneous distributed database product in June 1986.

INGRES is ideally suited for distributed computing environments because of its portability. The advantage of portability is that applications designed to run on a minicomputer can run unchanged on a mainframe or microcomputer. Applications can be developed anywhere and run anywhere within an organization.

INGRES/NET gives users distributed access to all INGRES databases connected in a computer network, even under different vendor operating

environments. All INGRES tools and applications run interactively on the user's local computer, while INGRES information from remote computers can be accessed as necessary. INGRES/NET is optimized for speed in interactive applications and overall system throughput. The number and size of messages are reduced with INGRES/NET, thus reducing the cost of sending information over long distance lines.

INGRES/STAR is Relational Technology's open-architecture distributed database product. Distributed database systems enable organizations to develop applications and access data that span a variety of computer systems, with the same ease as if all information were resident on a single computer. INGRES/STAR differs from database networking products in that multiple computers can be accessed simultaneously. The user need not know where the data is located or protocols for accessing it. Both functions are handled transparently to the user by INGRES/STAR.

INGRES/STAR's open architecture enables the distributed database to operate over dissimilar hardware, operating systems and networks. The product even provides gateways that will enable other vendors' database management products to interface with the distributed environment. INGRES/STAR is a major technological innovation that will help resolve the significant problem of corporate data being dispersed across a number of normally incompatible environments, often referred to as the "Islands of Information" problem.

Integrated Tools

Relational Technology is a pioneer and leader in the integration of application development and end-user tools with relational database management systems. INGRES offers both a fourth generation application development environment and end-user decision support tools.

INGRES's fourth generation application development environment includes three productivity levels. Each level is fully functional on its own and can be easily accessed from any other level and intermixed within the same applications. This gives the user maximum flexibility to prototype, create and maintain applications of arbitrary requirements totally within the relational database system.

At the first level, INGRES's application development environment gives users forms-based Visual Programming that allows data to be queried and update through a form displayed on the terminal screen. The form includes a menu of operations. The user may enter data into the fields of the form or execute simple operations by selecting menu items. A visually-oriented forms editor allows a user to customize the form. With Visual Programming, non-technical user productivity is increased because the user can build a wide variety of useful applications without programming knowledge.

With INGRES/APPLICATIONS, which includes INGRES/4GL and Applications-By-Forms, users can develop sophisticated applications through a "non-procedural" fourth generation language (4GL). The user tells the system what is to be done rather than how to do it. INGRES/APPLICATIONS allows users to share and manipulate information without writing, documenting or debugging traditional programming code. This level includes the use of SQL and a wide variety of other application-oriented commands for building sophisticated multi-user applications.

The third level provides the highest level of capability for the technical user. The programmer can embed 4GL commands and SQL statements in any of seven traditional programming languages: Ada, BASIC, COBOL, C, FORTRAN, Pascal and PL/1, the widest array of languages supported by any database management system vendor. In this way, sophisticated queries and complex calculations can be included through the use of embedded SQL commands

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instead of requiring the programmer to re-program the action in a procedural language.

INGRES's Visual Programming tools also provide end-users with decision support capability. End-users can easily design ad hoc queries, reports and graphs without programmer assistance. By allowing end-users to access some of the corporate data they need, organizations can lower demands for MIS assistance and reduce the applications backlog.

INGRES/PCLINK provides personal computer users with a bridge to PC personal productivity tools from INGRES databases on a host system. PC users can access information in host INGRES databases and applications using a familiar PC-oriented Visual Query Language. The product allows personal computer users to browse through the contents of INGRES databases on other computer systems, extract data, transfer the data across a network and store and manipulate the data in the users' personal computer files. INGRES/PCLINK automatically reformats data collected from host systems to conform with personal computer software packages such as Lotus 1-2-3, dBase, Wordstar and Multiplan.

The company's concentration on integration of tools allows INGRES users to develop applications faster and easier than with other available products. Because INGRES integrates application development with a relational database management system, it has broader capabilities than either a stand alone database management product or an application development product. INGRES supports the management of a wide range of databases from simple to extremely complex. With INGRES, end-users can develop simple applications, while programmers can create sophisticated applications in a short time; thus, application backlog is reduced and even eliminated.

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High-performance SQL

Relational Technology's objective is to provide a powerful database management system that allows the broadest possible use of INGRES within an organization.

INGRES's SQL database language is broadly compatible with IBM's DB2. Applications can be moved between INGRES and DB2 with minimal effort. As a result, INGRES can complement DB2 in an organization by running the same applications on mini and microcomputers as DB2 runs on the IBM mainframe. Alternatively, organizations can choose INGRES as their single database management system running on all computers from mainframes to micros.

INGRES's SQL also adheres to the ANSI Level 1 and X-OPEN SQL standards Relational Technology's Carol Joyce is vice-chairperson of the ANSI committee setting an SQL standard.

INGRES has performed consistently well in benchmarks and has been chosen as the database of choice by hardware vendors and customers alike. It is able to perform complex operations like unlimited inquiry and analysis of information which are not possible with competitors' products. In addition, it offers complete support for transaction oriented applications.

INGRES performance has improved in every major release since it was introduced in 1981. INGRES Release 5.0 has demonstrated 30 to 40 percent performance gains for complex queries and up to 50 percent for transaction processing (TP1) over its predecessor, INGRES Release 4.0. Relational Technology sees gains of 40 percent or better as reasonable annual performance enhancement targets during the next several years.

MANAGEMENT

Gary Morgenthaler, chairman of the board of directors/chief executive officer (CEO), is also a Relational Technology founder. He has 15 years of experience in high-technology product marketing, finance, development and design. Prior to joining Relational Technology in 1980, Morgenthaler was a consultant with McKinsey & Company Inc., advising major U.S. and European companies on marketing, operations, finance, strategy and research and development. Before McKinsey & Company, Morgenthaler worked at Tymshare, as manager of systems development, where he was the principal architect of the company's distributed applications network architecture. Morgenthaler holds a B.A. from Harvard University.

Paul E. Newton, president, chief operating officer, joined Relational Technology from UCCEL Corporation where he was senior vice president and general manager of their Systems Software and Financial Software Divisions. Newton joined UCCEL in 1968 as a development engineer. In 1976 he became director of software marketing and was promoted to general manager of the Systems Software Division in 1981. Newton earned a BS in Physics and an MBA from the Massachusetts Institute of Technology where he wrote a thesis on the application of databases in large organizations.

P. Michael Seashols, vice president of sales and marketing, joined Relational Technology from Oracle Corporation where he spent two and one-half years as vice president of sales. Prior to Oracle, Seashols spent 11 years with IBM in sales and marketing and three years with National Semiconductor as marketing director for National Advanced Systems. Seashols was also involved in founding two technology companies, one a supplier of multiuser computer systems and the second a LAN software supplier. He has a B.A. in Mathematics from Manchester College in Indiana.

Michael D. Dion, vice president of engineering, has over 18 years of experience developing and marketing computer products. Dion joined Relational Technology as director of UNIX systems and was promoted to vice president in September 1986. Prior to joining Relational Technology, Dion managed engineering and marketing staffs at Intel Corporation for 11 years. Dion also served as a systems analyst and senior systems programmer at General Motors Corporation for 10 years. He holds a bachelor of engineering degree from the General Motors Institute in Flint, Michigan.

Nicholas Birtles, vice president, international operations, has more than 17 years of experience in the computer software and services field. Before joining Relational Technology, Birtles spent 13 years with Comshare, most recently as its European sales director, where he was responsible for 12 sales offices in the U.K., with subsidiaries in Belgium, the Netherlands, France and Germany. Prior to Comshare, Birtles worked in sales support for Burroughs in Canada and, before Burroughs, for English Electric/Marconi as a systems engineer.

William Smartt, chief financial officer and vice president, finance and administration, joined Relational Technology from Di Giorgio Corporation where he was vice president, finance and administration. At Di Giorgio, Smartt was responsible for raising more than $100 million in capital. Prior to Di Giorgio, he served as director of accounting for Fairchild Camera and Instrument Corporation, where his responsibilities included developing and managing worldwide accounting policies. Smartt received a BS degree from UC Berkeley.

Lawrence Rowe, consulting vice president, co-developed the INGRES prototype at UC Berkeley and helped develop a commercialized version as co-founder of Relational Technology. As associate professor of electrical engineering and computer science at UC Berkeley since 1976, Dr. Rowe has served as a consultant for Apple Computer and Tandem Computers, and has written extensively on programming languages, database management systems and computer networks. He holds a Ph.D. in information and computer science from the University of California, Irvine.

Michael R. Stonebraker, consulting vice president and director, was the principal architect of INGRES in its developmental stages at UC Berkeley. He has served as a UC Berkeley Professor of electrical engineering and computer sciences since 1971. His most recent book, <u>The INGRES Papers, Anatomy of a Relational Database System</u>, summarizes the development of INGRES at UC Berkeley and Relational Technolgy. Dr. Stonebraker holds a Ph.D. in computer information and control engineering from the University of Michigan.

Eugene Wong, consulting vice president and corporate secretary, was also a key member of the INGRES design team. He is chairman of the UC Berkeley electrical engineering and computer sciences department where he has served as a professor since 1962. Dr. Wong has worked on the research staff at IBM and served as a consultant to Ampex Corp. and Honeywell Corp. He holds a Ph.D. in electrical engineering and computer sciences from Princeton University.

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