A CAHNERS PUBLICATION FEBRUARY 15, 1987 SIX DOLLARS

Electronic Business

Factory automation at Westinghouse and IBM

Parallel processing: Strategies for an expanding market

Tandem's Treybig: Fault-free visions of an expanding niche

Tandem: Growth in a niche that never fails

James Treybig does not mind being called a niche player these days. His strategy has reaped nearly $1 billion

By Anne Knowles

Being traditionally thought of as a niche market player isn't the worst thing in the world — especially when your niche protects you from the market giants while widening at a strong rate. Tandem Computers Inc., the Cupertino, Calif., maker of fault tolerant computers — systems designed to fail rarely, if ever — has continued to enjoy a protected niche status throughout the computer industry's upturns and downturns. The company's unique systems design, based on multiple processors and a proprietary operating system, sets the 10-year-old company apart, pegging it as a supplier to the relatively small fault tolerant market. But Tandem's success has caused it to start looking beyond its safe haven and has caused other companies to covet Tandem's business.

Consider Tandem and the business it is in. Larger computer manufacturers have shied away from the fault tolerant market, in part, because of the inherent difficulties of designing fail-proof architectures. Meanwhile, Tandem has emerged from a near thorough shakeout in the fault tolerant market, in the process rising to the top of the heap and capturing over 80% market share. Most important, the reliability provided by such systems has become increasingly attractive to more customers in markets outside fault tolerance. Add that up and you have a $768 million company for the fiscal year ending Sept. 30, 1986, and a firm now considered a major force in the computer industry. Says Kimball Brown, an industry analyst with Dataquest Inc., a market research firm in San Jose, Calif.: "The three companies that are the biggest threat to IBM are Digital Equipment Corp., NEC Corp. and Tandem."

No small praise for a niche market player. In fact, says James G. Treybig, Tandem's president and chief executive, he no longer minds Tandem being tagged a niche player. "I used to not like that word, niche," says Treybig. "But I don't think it's negative. We're choosing niches. By choosing where we fight and win we can be quite a big, profitable company."

Today Tandem is trying to do all of those things. And the company's so-called niches are more numerous now than they have ever been. Tandem is targeting vertical markets — from transportation to retail point-of-sales — that fall under a larger market umbrella called on-line transaction processing (OLTP). While traditional fault tolerant applications — those applications where system failure can be disastrous — represented only a $738 million market in 1985, OLTP — defined as the execution of transactions in real time — reached an estimated $20.3 billion last year, according to Dataquest. By 1990, projects Dataquest, OLTP will be a $35 billion business, accounting for about 70% of all new computer sales.

Because of this, larger computer makers are finding the OLTP market too alluring to ignore. And, as Treybig says, Tandem is fighting. IBM already has about 54% of the OLTP market because of its preeminent position in the mainframe market. (Most OLTP applications are supported by a host computer, which, as a general rule, is a mainframe containing a database. A front-end processor provides fault tolerance, safeguarding data in case any

AT A GLANCE

Tandem Computers Inc.
Cupertino, Calif.

	FISCAL YEAR COMPARISON		
	1985	**1986**	**Change**
Sales ($ thousands)	$624,138	$767,793	+23.0%
Net income ($ thousands)	$34,374	$63,766	+85.5%
Net income/sales	5.5%	8.3%	–
Cost of sales/sales	38.5%	32.3%	–
R&D/sales	11.5%	11.3%	–
Marketing, G&A/sales	42.0%	42.6%	–
Capital expenditures/sales	10.8%	8.5%	–
Number of employees	5,494	5,719	+4.1%
Sales per employee	$113,604	$134,253	+18.2%
Net income per employee	$6,257	$11,150	+78.2%
Current ratio	4.44	3.87	–
Debt/equity ratio	0.01	0.01	–

Fiscal year ending September 30.

Source: Dow Jones News/Retrieval

HEEEEEEERE's JIMMY: Tandem president James Treybig regularly takes to the in-house company network to discuss strategy

Liane Enkelis

other part of the system fails. At the end of the network, depending upon the application, are various kinds of terminals, such as personal computers or cash registers, which can access or alter the database in real time.)

But, says George Weiss, an analyst with Gartner Group Inc., in Stamford, Conn., "OLTP is moving toward distributed processing and departmental systems, away from mainframes." Because of that, IBM has fortified its OLTP offering through an original equipment manufacturer (OEM) agreement with Stratus Computer Corp., of Marlboro, Mass., for a low-end fault tolerant system that IBM calls the System/88. And Stratus, bolstered by IBM's stamp of approval, and despite the fact it is one-sixth the size of Tandem, has proven to be the most viable fault tolerant alternative to Tandem. In particular, Stratus' strengths — low-end systems and the East Coast sales territory — have been Tandem's weaknesses.

In more specific markets Tandem is treading on the toes of other major manufacturers. In retail, which currently represents 5% of Tandem's revenue, NCR Corp. has been the historical favorite due to its point-of-sale terminals. In April, NCR shored up its product line with the announcement of its 9800 series mainframes incorporating fault tolerant features.

Digital Equipment is expected to announce enhancements to VMS, its operating system, that will make the company a more competitive threat in OLTP. But DEC's systems, says the Gartner Group's Weiss, are not optimized for OLTP applications. "DEC has a long road on this one," says Weiss. Despite that, DEC dominates manufacturing, a market that accounted for 21% of Tandem's 1986 sales. Concludes Treybig: "In all the industries where there are engineers we have DEC. And in all the industries where there aren't engineers we have IBM."

According to Treybig, however, Tandem is winning in those markets that it is zeroing in on. Tandem equipment is used in 19 stock exchanges. In telephony, where Treybig says Tandem is safer because of the lack of IBM penetration, the company supplies processors to Pacific Bell, Southwestern Bell and US Sprint. Tandem computers automate manufacturing at Apple Computer, Audi and Hughes Aircraft Co.

"In point-of-sale, we have literally every major bank. We have big retailers like Target and [J.C.] Penney. We have people in the supermarket area like Safeway and Kentucky Fried Chicken. We have every major petroleum company in the U.S., except one. And that one is a Penney's customer, and Penney is a Tandem customer. That's a niche," says Treybig. "And we won it all."

Low-end lure

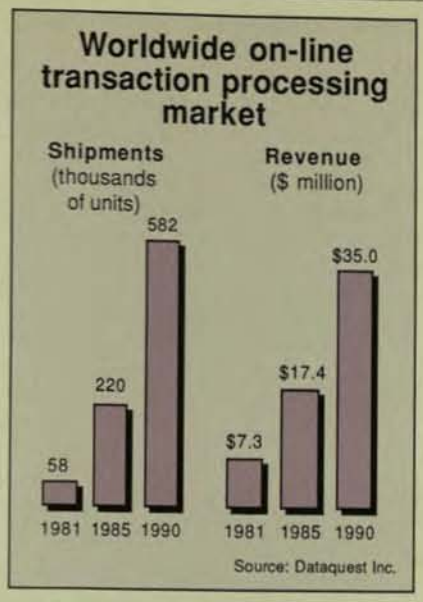
Tandem hasn't won it all yet. But the company is systematically addressing gaps in both its marketing and product line that have hindered it

before. Treybig is the first to admit the mistakes made in the past. "We didn't do a good job on third parties. We didn't build products in the lower price range and that was a strategic mistake. We didn't do a good job, for example, on major account support. Five years ago we were lucky to sell a customer one system," says Treybig.

The remedy, says Treybig, is to concentrate on sets of solutions rather than individual products. "I think the importance of solutions is that the customer buys one and then they can buy a second one much sooner. And a third and a fourth," says Treybig. And each time, adds Treybig, it becomes, "easier to convince them to buy it."

To soldify its solution sell, Tandem is broadening its product line. Already, says Gartner Group's Weiss, "Tandem has the strength at the high-end." Tandem's TXP, with an average selling price of $450,000, accounts for approximately 75% of the company's revenue. Tandem's VLX, announced last April, has a processing range of 40 to 160 transactions per second (TPS), a price tag starting at $1 million and currently represents about 20% of the company's revenue. It is also the first Tandem system that encroaches on IBM's mainframe turf. Another high-end processor, code-named Cyclone, which analysts project will be 50% faster than the VLX, is expected next year.

In the midrange, Tandem rejuvenated its product line with the EXT-10 and EXT-25, announced last August. Says Treybig: "Our success this year is going to come from the VLX, EXT-10 and EXT-25." But from a new product point of view, Treybig says, 1987 will focus on the low-end.



Treybig says that the announcements will involve entry-level systems, application generators and database software. Specifically, most industry analysts believe Tandem will announce three low-end systems designed to compete more effectively, on a price basis, with DEC, Stratus and other rivals. By midyear, Tandem should unveil its first system based on complementary metal-oxide semiconductor (CMOS) technology. Jonathan Fram, an analyst with Bear, Sterns & Company Inc. in New York City, contends the system may also be Tandem's first uniprocessor configuration. A single processor computer, says Fram, would not be capable of fault tolerance but would act as a node on a network.

Tandem will also announce its second computer which will run a standard operating system. Already the company sells PC AT-compatible machines, which it buys from Tandon Corp. that run MS-DOS. The company is buying Altos Computer Systems' 3068 machine, based on Motorola Inc.'s 68020, 32-bit chip and the Unix operating system. Industry observers disagree over whether the machine will contain single or multiple processors. But these observers believe the system is designed to enable Tandem to bid on contracts which require Unix.

Asked if the company will ever offer Unix on a proprietary Tandem computer, Treybig says, "We're going to offer more than the Altos." Asked if offering Unix, a standard system offered by many vendors, could turn Tandem hardware into a mere commodity, Treybig contends, "The reason people like Unix is the perceived ease of programming. But application

Liane Enkelis

MICHAEL BATEMAN, vice president for third-party marketing and **GERALD PETERSON,** vice president for marketing, manage Tandem's thrust into the OEM and VAR market

generators are going to replace that. When that point gets here you don't care that the underlying hardware is microprocessor based running Unix or whether its gate arrays running our operating system."

Tandem's hardware design, today, uses multiple processors with their own memory. Because of that, the systems are easily expandable. Additional processors can be added onto a system without the performance degradation created when more processors try to access the same memory.

Tandem's proprietary operating system, Guardian, manages the flow of data between the processors' memories. It is a message-based system. The importance of this is that if processor A, for example, needs data located at processor B's memory, the system will send a message requesting that the information be transferred to processor A. To users on a network, says Fram, all data looks local. The net result, says Dataquest's Brown, is the only truly distributed processing system on the market.

In addition, Tandem's Multilan product, announced last November, enables users to connect to any local area network (LAN) supported by IBM's Network Basic Input/Output System (NETBIOS). "Tandem's made great strides in LAN interfaces," says Tony Fernandez, a staff manager with Pacific Bell. Pacific Bell uses Tandem's NonStop II and TXP systems and Tandem's Expand networking software.

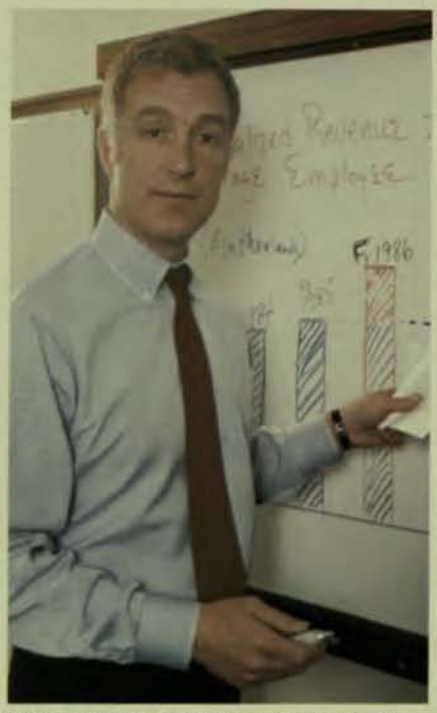
But he is dissatisfied with Tandem's datacommunications products and, recently, with the company's software support. "We're not getting any," says Fernandez. He would also like to beta test Tandem's Teseract product, the company's as yet unannounced database system. But Tandem, says Fernandez, wants Pacific Bell to buy a VLX to do the testing on. "It's power politics," says Fernandez. "We've always had a very good relationship;" but, he says he is now having problems with Tandem that he hasn't had in the three years since Pacific Bell first purchased its Tandem system. "That happens with change," Fernandez says.

Competitive alliances

Things are changing at Tandem. In the past, Tandem has depended primarily on direct sales to price-insensitive *Fortune* 1000 customers. Today, OEMs and value-added resellers (VARs) still only represent 7% of Tandem's sales. But with the thrust into the low-end, Tandem marketing is changing its look.

The process began with a reorganization of the company's third-party marketing division in October 1985. Today, it is called the Alliance program. Under this umbrella falls all of Tandem's OEMs, software developers and VARs. This program is managed by Michael K. Bateman, vice president for third-party marketing.

The Alliance program is broken into five categories. Solution implementers, says Bateman, include consultants like Arthur Young & Co. which will install computer-integrated manufacturing (CIM) turnkey systems for Tandem customers. Tandem writes its own systems software, such as Encompass, the company's database product; and independent software vendors (ISVs) develop programming tools for Tandem systems. Tandem makes the sale, says Bateman, and splits the revenue with the ISV.



DAVID RYNNE, Tandem's chief financial officer: "We restored our margins to very acceptable levels in 1986"

Tandem has had considerable success signing up software houses which write application packages. The company's list of third-party software writers has grown from 35 in 1983 to 250 today. Bateman estimates that one-half to two-thirds of Tandem's new customers are influenced by a third party.

Two third-party software houses, under the direction of Susan L. Hailey, Tandem's retail industry manager, clinched the deal on Ross Stores, according to Gerald L. Peterson, Tandem's vice president for marketing. Signorum Inc., Fremont, Calif., and LeRoux, Pitts & Associates Inc., Clearwater, Fla., jointly developed StoreLink, a fault tolerant retail point-of-sale control system. Ross Stores was able to tie together sales and inventory at 146 stores, each with an average of 10 NCR cash registers, using the software. In the process, Ross replaced six NCR minicomputers, used at night as batch processors, with a Tandem TXP. "NCR didn't have a solution," says Peter Hart, vice president for information systems with Ross. "We needed a vendor to provide a single solution."

Tandem has about 10 classical OEM relationships. System Integrators Inc. in Sacramento, Calif., is Tandem's largest OEM. SI sells turnkey publishing systems, built around all of Tandem's processors except the VLX, to such customers as *The Washington Post*, *The Los Angeles Times* and *The Chicago Tribune*. According to Stephen Nilan, SI's director of marketing, Tandem systems were chosen because of their modular expandability, reliabilty and communications capabilities. (SI uses Tandem's networking software called Expand.) Even though DEC products were evaluated by SI, Nilan says that the company didn't want, "just another me-too product."

But SI has had its problem with Tandem. The VAR would like to expand its customer base to smaller publishers and is looking forward to low-end products Tandem is expected to announce this year. "We've had a problem moving downward," says Nilan. "And our margins are being squeezed." In addition, says Nilan, SI thinks the price of the TXP, which hasn't been cut since the introduction of Tandem's high-end VLX, should better reflect market conditions. But, adds Nilan, "we're so far down the road with Tandem we can't think of changing."

Tandem is hoping the same isn't true of DEC's VARs. The company's most recent, and industrious, project under Alliance has been the courting of VARs that are dissatisfied with DEC's discount schedules. In September of last year, Tandem contacted over 1,100 DEC VARs. A telemarketing campaign was carried out by a consultant in October and a teleconference was broadcast to 26 cities. Treybig does not expect to see con-

Liane Enkelis

crete results from the program until mid-1987. But he says he would be content with three or four VARs on the East Coast — where DEC has a stronghold and Tandem has a hole. According to Philip A. Stack, regional Alliance program manager for the Northeast, the company was at the contract stage with that many eastern VARs in December.

Cutting costs

Through all this change, Tandem has certainly been profitable. In Tandem's latest fiscal year, ended Sept. 30, revenue rose 23% while net income climbed 86%, to $63.8 million. Tandem's operating margins, at 13.8%, are the highest they have been in five years. Operating income spiraled 112%, to $105.9 million. Tandem's pretax profit margins stood at 13.8%, better than industry wunderkind DEC. And net income as a percent of sales jumped to 8.3% from 5.5% in 1985.

But, it has been a few years since Tandem's income statement looked so good. In the early 1980s, the company was predicting it would be a billion-dollar company by mid-decade. At the time, Tandem had the growth rates to substantiate such claims. In 1980, Tandem raised its net income 117% on a revenue increase of 95%. The following year revenue rose 91% and net income soared 148%. But, by 1984, an economic snafu hit the industry and Tandem's revenue growth slowed to a respectable 17%. But net income plunged 20%.

"We built expenses faster than we should have, given the decrease in growth rates," explains Treybig. In response, like many other computer manufacturers, Tandem implemented cost cutting measures that started in manufacturing and led to stiffer personnel policies, including short-term hiring and salary freezes.

About three years ago, says David J. Rynne, Tandem's chief financial officer, the company put in place various "nuts and bolts" improvements to expedite the production process. Included was a revamping of manufacturing protocols that cut back on overtime. During the slower first two months of a quarter, says Rynne, manufacturing prebuilds subassemblies needed for the hectic last month of the period. Stricter quality-control procedures were imposed on suppliers. In the end, says Rynne, reducing the cost of production resulted in a drop in the cost of inventory.

"But manufacturing is only half the story as it appears on the P&L [profit and loss]," statement, says Rynne. The other half, says Rynne, is savings from newer technologies incorporated in newer Tandem products. Tandem's VLX, for example, is based on very large scale integration (VLSI) chips developed jointly between Tandem and Motorola Inc. In addition, the MCA2800 ALS, the processor designed by the two companies, has now become a standard product offering at Motorola, which has additionally reduced the cost and guaranteed volume production for Tandem.

Tandem's VLX is based on VLSI chips developed between Tandem and Motorola

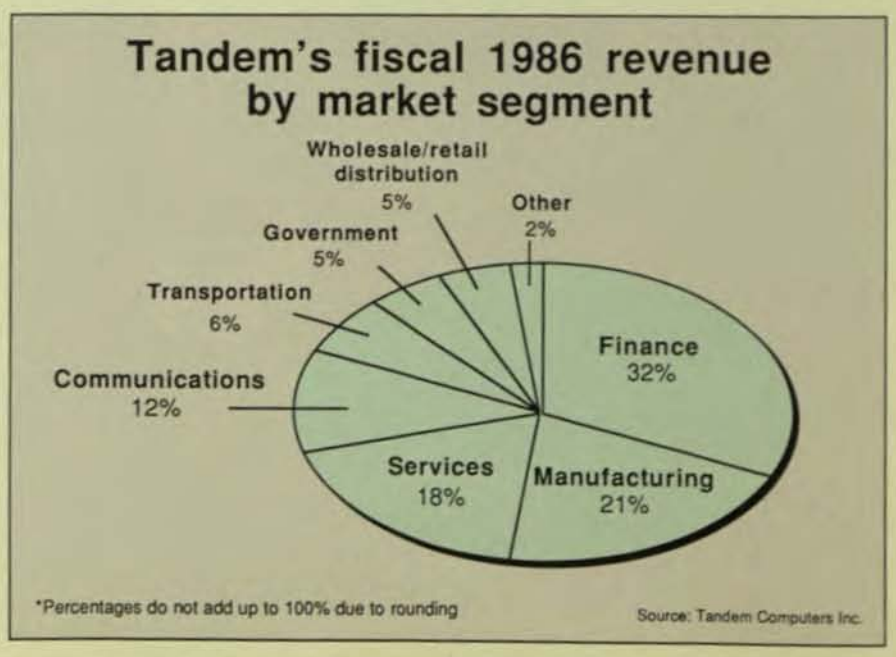
Bear Sterns' Fram believes the VLX has a preexisting upgrade built into the first model. The VLX, which uses both emitter coupled logic (ECL) and transistor-transistor logic (TTL), has the same 83 nanosecond clock cycle as Tandem's previous high-end offering, the TXP. What Fram and other analysts expect is a complete ECL implementation of the VLX — which will use the same chassis, have better performance and a higher price tag, and all without increasing Tandem's manufacturing costs.

The end result, for Tandem, has been an improvement of gross profit margins, from 61.5% in 1985 to 67.7% in 1986. But those benefits will be flattening out this year and, in fact, says Treybig, Tandem has to raise its inventory level above the $64 million recorded at year end. "We restored our margins to very acceptable levels in 1986," says Rynne. "We don't aspire to improve them."

But this year Tandem is changing its accounting practices in regard to selling, general, and administrative (SG&A) costs because of an order from the Securities Exchange Commission. The result will be a slight drop in both gross profit margins and SG&A expenses. SG&A costs, at 42.6% of sales, have always been above the norm due to the customer hand-holding needed to sell Tandem systems and because of the high cost of competing against IBM.

Tandem's 1986 balance sheet was equally impressive. The company ended the year with virtually no long-term debt — $4.5 million — and a lot of cash — $239.8 million. According to Rynne, Tandem hopes to buy five or six buildings it now leases in Cupertino. In addition, the company may make investments in, or acquisitions of, companies developing technology that is pertinent to Tandem's business. Already Tandem has equity investments in numerous companies. With Pacific Bell, Tandem has a 24.5% stake in Integrated Technology Inc. of Plano, Texas, for telecommunications network systems. And in March, Tandem invested in Triplex, a maker of fault tolerant programmable logic controllers.

And finally, says Rynne, Tandem can use the money to finance further growth. □



Reprinted from **ELECTRONIC BUSINESS** February, 1987

HOW JIM TREYBIG WHIPPED TANDEM BACK INTO SHAPE

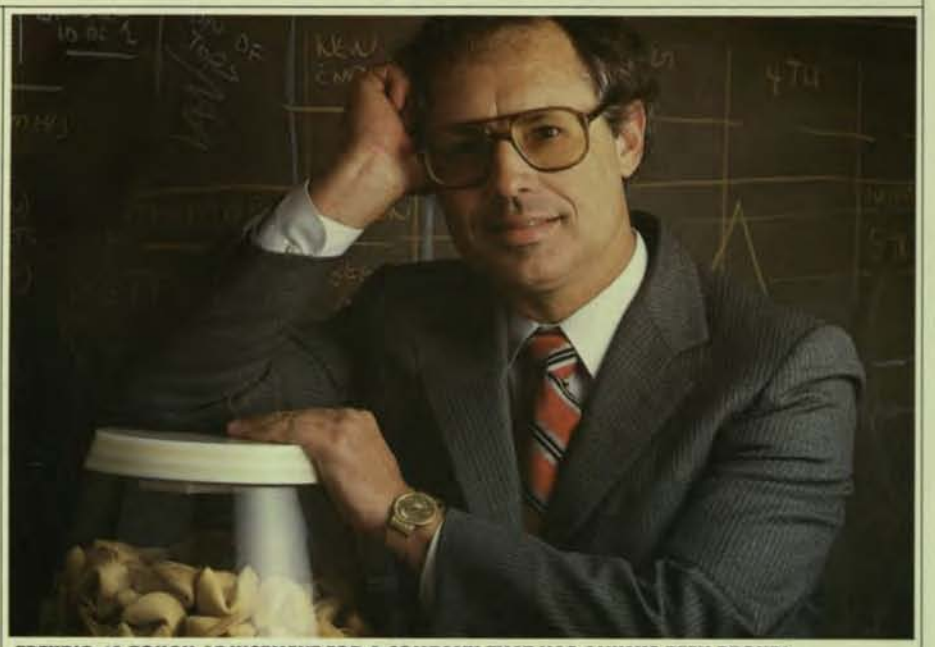
The founder has revamped products and marketing, gaining new respectability

Jim Treybig had a life plan. Fearing that a single career would get too boring, the plain-talking Texan set out to get rich by running his own business. After that, he figured, he'd get elected governor of Texas, then retire to dig up ruins in the Yucatán. Treybig, 46, still has plenty of time to get to Mexico. But after 20 years in California, he's been away too long to enter Texas politics. Besides, managing his company, 12-year-old Tandem Computers Inc., has proved to be anything but boring.

Tandem hit the minicomputer market like a shot with a design for almost faultlessly handling rapid-fire transactions, such as bank-account debits or airline reservations, as they happen. That technical wizardry sent the Cupertino (Calif.) company's revenues and profits doubling every year from 1976 to 1981. Vice-President Dennis L. McEvoy recalls: "We thought we could walk on water." Then reality set in. Tandem outgrew its lax cost controls, enduring four years of flat earnings. Margins sagged. Its stock plummeted. "It was a tough adjustment for a company that has always been proud," Treybig says.

PERFECT TIMING. Realizing that Tandem was on a collision course with mediocrity, Treybig whipped it into fighting trim. In the past two years, the company has virtually replaced its line of products with a broader array, revamped its xenophobic marketing strategy by working with outside software companies, honed manufacturing efficiencies, and tightened financial controls.

The result: Profits shot up 113%, to $27 million, in the quarter ended Dec. 31 after rising 86%, to $68 million, in the year ended Sept. 30. Revenues jumped 23% last year, to $768 million, and the stock leapt in January to a five-year high of 58. No wonder analysts compare Tandem's new growth with the turnaround of Digital Equipment Corp. in 1985. John C. Levinson, an analyst at Goldman, Sachs & Co., expects earnings to jump 67% this year, to $2.40 per share. "Tandem has got its act together," he says, "and at a time when IBM's at its weakest."



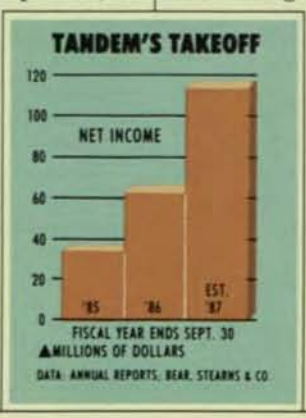
TREYBIG: 'A TOUGH ADJUSTMENT FOR A COMPANY THAT HAS ALWAYS BEEN PROUD'

Tandem's efforts have also catapulted it to a new respectability in the market. Once relegated to selling systems mainly for isolated uses, such as networks of automated teller machines, Tandem is nosing its way into other areas, such as automated manufacturing operations. That's because its machines can manage vast networks, expand capacity, and link up to other makers' hardware easily. It's also scoring more wins against chief rivals International Business Machines Corp. and DEC. "Tandem's gone from being a vendor of specialized offerings to where it can compete with most of the majors for most applications," says Loran R. Fite, a vice-president at Wells Fargo Bank, a Tandem customer.

Unlike Steven P. Jobs of Apple Computer Inc., M. Kenneth Oshman of Rolm Corp., and other Silicon Valley entrepreneurs of the 1970s, Treybig is still at the same company. Even rarer, so is most of his original management team, which has been reinforced with recruits from IBM, Burroughs, and Bechtel to help run sales, operations, and financial and strategic planning. "No heads rolled," says Chairman Thomas J. Perkins, the venture capitalist who bankrolled Tandem's startup. "That's a measure of strength."

Not that it was easy. By mid-1984 it was clear that Tandem's narrow product line was limiting its appeal. Treybig sped work on both higher-powered and smaller, less-expensive systems. He also pushed through a raft of new storage devices and software. Last year the new products accounted for 75% of sales.

By then Treybig had also tackled marketing. Tandem had always thought that its fault-tolerant design was its best sales advantage. But surveys of customers showed that they were buying more for other features, such as Tandem's ability to track and update data between far-flung offices. So Treybig changed the sales pitch and beefed up what had been a skeletal headquarters group to focus on industries such as telecommuni-



PHOTOGRAPH BY ROBERT HOLMGREN, CHART BY SPENCE

cations and manufacturing. Before, "the sales crews were grabbing any customer they could find," says Gerald L. Peterson, marketing vice-president.

Treybig also realized that he needed to work with outside software publishers to reach new markets. It was a late discovery that DEC and others had made years before. But Treybig and Peterson followed suit. They set up a separate group of 100 specialists and three support centers around the country in late 1985 to do nothing but pamper software houses. In the past year, Tandem has tripled its software coterie to 225 companies, many of them customers whose programs Tandem markets to others. "Tandem probably has the best third-party program in the industry," says Carol E. Muratore, an analyst at Morgan Stanley & Co. Adds Neal C. Hansen, president of Applied Communications Inc., a banking software house in Omaha: "It's a different company from two years ago."

Tandem has also established a special group to strike up joint ventures. Tapping Tandem's $240 million cash hoard, the group is investing in promising software vendors, for example.

THROUGH HOOPS. Customers have voted with their checkbooks. Allegheny Ludlum Corp. chose Tandem this year over DEC to automate the flow of data between its Pittsburgh headquarters and five steel mills. Financial Interchange Inc. of Houston, the largest regional banking system in the U. S., picked Tandem to replace an IBM mainframe to run the "Pulse" network of 4,000 ATMs from 1,800 financial institutions. Financial Interchange President Stan Paur calls that "one of the major marketing coups in this industry."

Tandem will need its renewed momentum to fight increasingly tough competition. Recent new products from DEC will challenge Tandem as the market for so-called on-line transaction processing heats up. Then there's Stratus Computer Inc., which makes fault-tolerant machines that IBM has resold since 1985. In January, Stratus introduced a system that offers more power than Tandem's for 75% of the price. Though Stratus lacks such nifty Tandem features as the ability to locate data easily anywhere on a worldwide network, "these are very strong offerings," says Kimball Brown, an analyst with Dataquest Inc., the market research firm. Tandem is planning a counterattack. It will bring out three new processors and software-programming tools this summer to solve shortcomings in its product line.

If Tandem jumped through hoops in the last two years, so did Treybig. Before the slide, his top managers say, he treated them as peers, relied on a consensus to make decisions, and seldom criticized products or strategy. But by the second year of flat earnings, Treybig was posting quarterly results on his door as a sign of his impatience. He also moved his office periodically to different departments to scrutinize operations. "Jim made the transition from team member to president," says Gerald D. Held, vice-president for new ventures.

That meant making tough decisions. By 1985, dozens of Tandem's 5,400 workers had bolted to competing startups, and morale was poor. But Treybig froze salaries and canceled sales-incentive programs. "For what was supposed to be a very flexible environment, people got pretty brittle," recalls Anthony D. Turner, director of applied research.

With the good times back, so is the old Tandem spirit, thanks in large part to a worldwide electronic mail system and in-house TV network that Treybig uses to keep in touch with employees. All the previous trappings of company culture, such as swimming pools, paid sabbaticals, and Friday afternoon beer busts, are still around, too—and more ingrained than ever. When a newly hired New York manager eliminated his region's Friday get-togethers last year to cut costs, his boss in Cupertino persuaded him to reinstitute them.

> During the tough times, Treybig froze salaries and canceled Tandem's sales-incentive programs

The company's recent success has caused a few growing pains. It has faltered a few times in tying together its machines with customers' software, for instance. A slip-up in writing a piece of operating software recently delayed installation of a new reservations system at Western Air Lines Inc. for several months. Tandem has set up a small operation in Virginia to manage such jobs, and Held hints that Tandem may soon acquire a so-called system integrator that would help manage such projects.

Tandem could use the help. "The field has to deliver what seems a very firm commitment from Tandem top executives," says Mauro Weissman, president of Bedford Associates, the company that supplied Western's software. "We haven't seen that yet." With all he's been through in the past two years, Treybig should be able to overcome this latest challenge. But those ruins in the Yucatán might have to wait awhile.

By Jonathan B. Levine in Cupertino

systems program here, Air Force inspectors said the AIL division had improved on nearly all counts where the operation was rated deficient in the earlier review.

Under a $3.5 billion subcontract, Eaton/AIL is supplying the defensive avionics for the new strategic bomber, which is being assembled by Rockwell International.

The December review found "a significant drop in the number of deficiencies per item of hardware inspected," although "product quality remains a concern," according to a statement from the Contract Management Division. There was "noteworthy progress in manufacturing controls and material handling...Engineering management had improved, but problems still exist in acceptance testing and the control of system safety audits."

The Air Force concluded there

Litton Awards Tandem $2.5M AF Subcontract

CUPERTINO, Calif. — Tandem Computers Inc. will have its NonStop VLX transaction-processing systems used by the Air Force under a subcontract received from Litton Computer Services. The initial increment is worth $2.5 million to Tandem, while potential value of the subcontract is $18 million over 40 months.

Litton Computer Services, a Litton Industries unit based in Mountain View, Calif., last year received a $12.4 million contract to develop a Reliability and Maintainability Information System for the Air Force Logistics Command, which will track and analyze components used in weapon and avionics systems. Options granted over the next 11 years could increase the value of the pact for Litton to more than $115 million.

Tandem is scheduled to install seven-processor NonStop VLX systems at the command's five Air Logistics Centers in Utah, Oklahoma, California, Texas and Georgia, and an 11-processor system in command headquarters at Wright-Patterson Air Force Base, Dayton, Ohio.

Lear's Buyer Details Harvest of $2B Tender

NEW YORK — L Acquisition Corp., the company conducting the $2.1 billion takeover of Lear Siegler Inc., said its tender offer snared 17.75 million shares of Lear Siegler common stock, 98 per cent of those shares outstanding, and 90,593 shares of preferred stock, 84 per cent of those shares outstanding.

oric for Wang's sales and support personnel, Sloane cautioned that it did not constitute "an external announcement of a lot of things in there (the document)."

FTAM And X.400 MHS

However, OSI is in the works. "Wang is implementing OSI applications and will initially make available two OSI products: FTAM (File Transfer Access Management) and X.400 MHS (Message Handling Service)," according to the report.

Regarding Wang's introduction of OSI products, "the time frames of the product announcements and delivery dates are purposely left open due to the continuing process of product definition, which depends on firm standards," the report said.

The company plans to meld OSI and its Wang Systems Networking (WSN), which is the company's proprietary architecture. "WSN is based on a layered approach that is evolving into an open communications architecture consistent with OSI," according to the report.

Integrating OSI, WSN

Building on an April 1985 announcement of OSI support, "the next logical step in the evolution of Wang Systems Networking is therefore to integrate the ISO standards and CCITT recommendations within its networking architecture. To achieve that goal, Wang has adopted a migration strategy toward OSI, which comprises three

adopted by the industry and customers. The objective is to ensure that Wang-to-Wang and Wang-to-non-Wang communications are as seamless as possible. This integration process will take place not only at the application level, but also at the network management and network configuration level."

Net Mgt. Console

A network management console will be a significant entry point for OSI into the WSN framework. The report refers to Wang's Distributed Management Facility (DMF) a focal point for managing OSI networks. DMF, according to Sloane, is "our network manager used to monitor Wang networks," and will eventually support OSI networks, he said.

The report predicted that "DMF will not only provide the network administrator with a single view into all Wang network subsystems, but it will also be the vehicle to integrate the functions of our OSI-based products. This integration of OSI-based information into DMF will make our OSI network management unique in the industry and position Wang ahead of our competition."

Wang's chief competitors in the OSI marketplace are cited in the report as IBM and DEC. Indeed, Wang's document blasts IBM and DEC for superficial and cursory OSI support that flies in the face of public policy statements.

proposed as something closer to an applications programming interface (API), Twomey said. And, suggested Omnicom's Neumann, since most major computer manufacturers already support LU 6.2 or have it under development, they are not opposed to an OSI LU 6.2 verb set that permits program-to-program communications over non-SNA links.

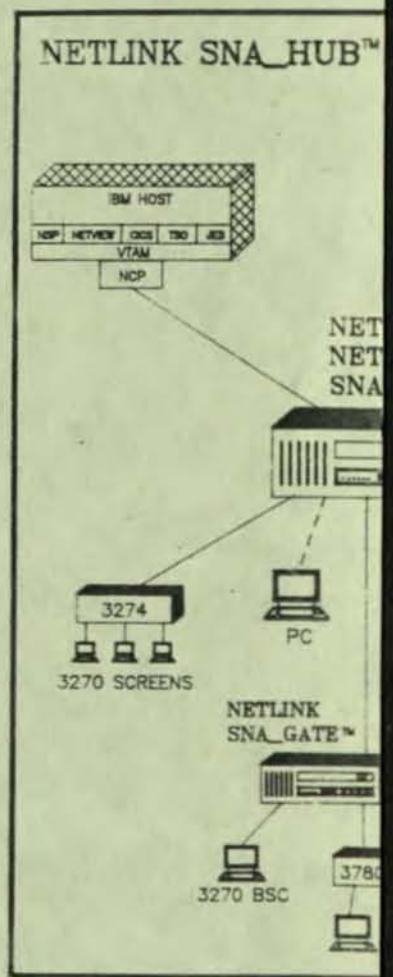
"I didn't detect any hostility by any manufacturer to anything that went around the table," Neumann said. "You have to bear in

'SNA Hub'

CONTINUED FROM PAGE 22

Method/Network Control Program (VTAM/NCP) in the host front-end processor is insulated from changes made downstream of the SNA Hub.

But the biggest difference between the SNA Hub and the S/88 is price. McCormick said. "The software alone to do this on the S/88 costs $24,000 per year," he said. "We cost $9,975. The difference is on the order of magnitude. Nobody is going to put in an S/88 as a remote concentrator." The SNA Hub is also considerably less expensive than the 3720 or



Async Controller Connects Tandem NonStop Systems

By SCOTT REEVES

CUPERTINO, Calif.—Tandem Computers Inc. has announced a VLSI-based communications controller for the company's NonStop systems.

The new 6106 Asynchronous Communications Controller is a single-board microprocessor-based controller. It manages data communications between a Tandem computer and remote devices such as terminals and printers.

The 6106 offers lower cost per line than previous Tandem asynchronous controllers, the company said. Like other controllers in the Tandem 6100 product family, part of the communications software that operates the 6106 is loaded into it by the Tandem system. Communications lines can be individually set with the 6106 to run a variety of asynchronous protocols, including custom protocols created by third-party software firms using a protocol development facility from Tandem.

The 6106 is scheduled to be available in the first quarter. It is priced at $5,760, the company said. Terminal and printer access method software is required to operate the 6106 controller and must be licensed separately.

For NonStop VLS and NonStop EXT systems, the initial license fee is $500 per system, with a monthly license fee of $80 per system. A one-time license fee of $4,180 per system may be selected.

For NonStop TXP and NonStop II systems, the initial license fee is $500 per processor with a one-time installation fee of $50 per processor and a monthly maintenance fee of $20 per system.

Four Processors

The 6106 uses four separate microprocessors, each of which has its own memory to support 16 separate communications lines that run asynchronous, point-to-point protocols. Dual ports connect the 6106 to the I/O channels of two processors in the host system and provide a backup path to each line, the company said.

The 6106 contoller runs on all Tandem NonStop systems and can coexist in a processor cabinet with all other Tandem controllers. The new controller's size and cost per line are oriented toward smaller configurations.

VLSI technology and more reliable components give the 6106 up to 300 percent better reliability than the asynchronous controller it replaces, the company said. In addition, on-line support and hardware self-tests improve fault isolation over previous asynchronous controllers.

MONDAY, FEBRUARY 2, 1987

New Tandem Software Automates Batch Jobs

CUPERTINO, Calif.—Tandem Computers Inc. announced software that lets users automate batch-job execution.

Available in two versions, the new software is called NetBatch and NetBatch Plus. Both versions act as a scheduler for batch jobs, giving users the ability to automate them on a Tandem system.

The NetBatch family is designed for on-line transaction processing users who need batch or sequential processing to print invoices, perform database searches or generate reports, the company said.

Users can access and work with data anywhere in a Tandem network and have either decentralized or centralized management of job scheduling in this network, according to the company.

Automatic execution and monitoring of batch jobs lets users focus on other activities, while still having the choice of responding to or intervening in certain stages of the job-execution process, Tandem said.

NetBatch Plus includes extra features and additional functionality. In addtion to providing a full-screen user interface, NetBatch Plus bundles the NetBatch software with DB Batch FE, which is a batch front-end product from MIS Information Systems Inc., San Jose, Calif.

DB Batch FE is a menu-driven interface that helps guide users through the job-scheduling process, Tandem said. The interface accommodates very complex batch environments, yet allows non-data processing personnel to run batch jobs, according to Tandem.

NetBatch is priced at $2,700 initial license fee (ILF), with a $200 monthly license fee (MLF) for Tandem's NonStop VLX, TXP and II systems. For the NonStop EXT, EXT10 and EXT 25 systems, NetBatch has an ILF of $1,350 with a $100 MLF.

NetBatch Plus is priced at $3,700 ILF, with a $340 MLF for NonStop VLX, TXP and II systems. It has a $1,850 ILF with a $170 MLF for the company's NonStop EXT systems. **–Irwin Greenstein**

2/9/87

To: Jerry Reaugh Loc: 4-15

Date:_____

From: Corporate Information Center

To change/discontinue routing of clippings and articles, contact Barbara Nepple - MS 3-07.

LEVEL 1 - 3 OF 5 STORIES

February 2, 1987

SECTION: NETWORKING; New Products; Network Management; Pg. 46

LENGTH: 102 words

BODY:

Tandem Computers, Inc. has announced a very large-scale integration-based communications controller for its Nonstop systems, called the 6106 Asynchronous Communications Controller.

The controller is a single board microprocessor-based unit that is said to manage data communications between a Tandem computer and remote devices such as terminals and printers.

The unit supports 16 separately configurable communications lines that run asychronous, point-to-point protocols.

The 6106 Asynchronous Communications Controller is priced at $5,760.

Tandem Computers, 19333 Vallco Pkwy, Cupertino, Calif. 95014.

LEVEL 1 - 2 OF 6 STORIES

February 1987

SECTION: SYSTEMS AND EQUIPMENT; Pg. 63

LENGTH: 122 words

HEADLINE: MTech Releases Cash Management System

BODY:

MTech's Financial Software Division has released ACTION2000 Cash Management Plus, an in-house information reporting system.

According to the company, the system provides three alternatives to the delivery of fee-based services: 1) For banks with a fully automated back office, it provides a secure gateway for customer transaction requests and report generation; 2) for banks with limited back office capabilities, it provides complete information storage, information reporting and transaction initiation; and 3) for banks with partial back office automation, processing and storage of data can be divided between the host and ACTION2000 Cash Management Plus.

The system operates on Tandem fault-tolerant computer systems.

Tandem To Install 1,500-Unit Network

CUPERTINO, Calif.—Colonial Penn Group Inc. has selected Tandem Computers Inc. NonStop systems for a network that will provide connections for over 1,500 personal computers and terminals to its host systems.

Terms were not disclosed.

The company said the full network configuration is planned to be in place by the end of the year. It consists of a combination of Tandem NonStop TXP and NonStop II systems, it said.

MONDAY, FEBRUARY 9, 1987

MANAGEMENT INFORMATION SYSTEMS WEEK 11

TANDEM TECHNICAL REPORTS 86.1 & 86.2 ARE NOW AVAILABLE.

These and previous reports (listed below) may be obtained from the Corporate Information Center, 19333 Vallco Parkway, MS 3-07, Cupertino, CA, 95014-2599 USA. When requesting reports please include your mailing address, or location (& mail stop). Copies also may be picked up in person.

TR81.1 Approach to End-User Application Design, by Jim Gray

TR81.2 Transaction Monitoring in ENCOMPASS, by Andrea Borr

TR81.3 Transaction Concept: Virtues and Limitations, by Jim Gray

TR81.4 A NonStop Kernel, by Joel F Bartlett

TR81.5 Relational Data Base Management for On-line Transaction Processing, by Stewart A Schuster

TR83.1 EMPACT: A Distributed Database Application, by Alan Norman and Mark Anderton

TR84.1 A Technical Overview of the Tandem TXP Processor, by Robert Horst and Sandy Metz

TR84.2 Robustness to Crash in a Distributed Database: A Non Shared-Memory Multi-Processor Approach, by Andrea Borr

TR85.1 One Thousand Transactions Per Second, by Jim Gray, Bob Good, Dieter Gawlick, Pete Homan, Harald Sammer

TR85.2 A Measure of Transaction Processing Power, by Anon Et Al

TR85.3 Hardware Architecture and Linear Expansion of Tandem NonStop Systems, by Robert Horst and Tim Chou

TR85.4 An Approach to Decentralized Computer Systems, by Jim Gray

TR85.5 Four Case Studies on Distributed Systems, by Mark Anderton and Jim Gray

TR85.6 Varieties of Concurrency Control in IMS/VS Fast Path, by Dieter Gawlick and David Kinkade

TR85.7 Why Do Computers Stop and What Can Be Done About It?, by Jim Gray

TR86.1 The 5 Minute Rule for Trading Memory for Disc Accesses and the 5 Byte Rule for Trading Memory for CPU Time, by Jim Gray and Franco Putzolu

TR86.2 Fault Tolerance in Tandem Computer Systems, by Joel Bartlett, Jim Gray, and Bob Horst

Tandem Qtr. Net Climbs to $27M

CUPERTINO, Calif. — First-quarter profit at Tandem Computers Inc. increased better than twofold to $27,097,000, or 58 cents a share, from $11,648,000, or 28 cents a share, a year ago.

For the latest period ended Dec. 31, revenues were up 40 per cent to $198,725,000 compared with $140,293,000 in the like 3 months of fiscal 1986.

The company noted that international revenues increased 50 per cent, while U.S. revenues were up 33 per cent.

Tandem ended the fiscal 1987 quarter with $234.1 million in cash against $134.3 million at the like time last year.

3d-Qtr. Earnings Up 5% at Lee Data

MINNEAPOLIS — Lee Data Corp. earned $1.5 million, or 10 cents a share, for the third quarter ended Dec. 31, a 5 per cent increase from the year-previous net of $1.4 million, or 10 cents a share.

Volume, strengthened by orders from the BOCs, increased 31 per cent to $29.7 million from $22.7 million.

The firm said the latest results included a one-time gain of $152,000 on the closing of a networking business in suburban Boston last year (EN, May 19), while the fiscal 1986 quarterly net included a writedown of $294,000 from discontinued operations.

For the most recent 9 months, Lee Data's net increased 15 per cent to $3.8 million, or 27 cents a share, compared with the year-previous $3.3 million, or 23 cents a share, while volume rose 24 per

WASHINGTO
transactions of
pany officers,
Securities and
mission, showed
holdings:

Motorola Inc
Mitchell, presid
6,000 shares at $
reducing his di
40,693 shares. H
stock under a co

Telxon Corp.
Meyerson, chair
25,000 shares at
each, reducing
ownership to 54,

Datascope Co
Saper, chairma
25,000 shares a
each, reducing
ownership to 79
owns additional

Microsemi C
Frey, chief execu
24,000 shares as
ownership to 761,
shares. He also
indirectly.

Nanometrics In
Lewis, former vi
posed of 500 share
reducing his to
ership to 5,500 sh

Stratus Compu
Foster, presider
27,000 shares at
ducing his total
to 324,800 share
ditional stock inc

Tracor Inc.
McBee, chairma
11,467 shares as
total direct own
shares. He own
directly. Also,
Oliphint, vice-pre
of 7,621 shares at
ducing his total
to 7,621 shares.

A division of Dallas, Tex.-based E-Systems, is the prime contractor on Air Force project. If all options on the contract are exercised, the project could be worth about $12 million for Tolerant.

The deal buoys Tolerant—the fledgling computer maker has sustained four years of losses and canceled a planned stock offering last year. This contract could signal new financial strength for the company. "We would expect that at sometime in 1987 (Tolerant) will be making a profit—at least on a quarterly basis," said Jeff Canin, senior technical analyst for Hambrecht & Quist Inc. in San Francisco.

Tandem will supply Air Force hardware

By SCOTT HILDULA

Tandem Computers Inc. has won a U.S. Air Force contract worth up to $18 million during the next three years.

Cupertino-based Tandem, working as a subcontractor to Litton Computer Services in Mountain View, has shipped a $2.4 million computer system to Litton as part of the deal. The company will ship $8.2 million more worth of hardware in 1987 if the Air Force exercises all the options included in the Jan. 12 contract, said public relations official Tom Waldrop.

The Tandem/Litton team won the award, worth more than $115 million to prime contractor Litton, in an open competition against 190 competitors. Litton would not discuss its contract.

Waldrop said the Tandem contract will boost the company's sales but doesn't signal an increase in government contracting for the computer maker. "It's not a brand-new entry for us into Department of Defense or government work," he said.

While the award doesn't signify a change in direction for the company, it is indicative of Tandem's current growth spurt. "Tandem's on a real roll and they could cross the $1 billion mark (in sales) this year," said Jeffery Canin, a computer industry analyst for Hambrecht & Quist Inc. in San Francisco.

Tandem earned $67.8 million from sales of $767.8 million for the year ended Sept. 30, 1986. Revenues for the first quarter ended Dec. 31, 1986 topped $238 million, a 40 percent increase from the previous first quarter, and net profit rose 133 percent to $27.1 million. Government sales accounted for about 6 percent of Tandem's total sales during the last year, Canin said.

The Air Force will use Tandem's system to track its inventory of components for advanced weapons and avionics systems. Tandem also supplies computers to the Federal Aviation Administration, the U.S. Department of the Treasury and to the Navy's "Splice" program, which will keep track of the agency's spare parts inventory.

San Jose Mercury News
February 12, 1987

DIGEST

GM chairman predicts cost-cutting gains in '87

General Motors Corp. says it will save up to $3 billion this year and about $10 billion annually by 1990 through cost-cutting efforts — including plant closings, buying parts from low-cost outside suppliers, buyouts of white-collar workers and improved production efficiency. In a letter being sent this week to its nearly 1 million shareholders, Chairman Roger Smith said the No. 1 U.S. automaker has set "tough, near-term goals" to reduce expenses and improve profits. GM, which last year saw its share of the U.S. car market dip and its profits fall 26 percent, to $2.9 billion from 1985 levels, has been cutting back but had not previously provided dollar estimates. In addition, GM, often criticized for redundancy in its vehicle offerings, said Wednesday it will remove 39 passenger car models from its lineup by 1990. GM officials did not identify the cars targeted for phase-out.

TANDEM, BOEING TEAM UP: Boeing Computer Services Co. and Tandem Computers Inc. of Cupertino plan to team up to produce computer products for factory automation and network systems. The two companies' products will be used for such tasks as document handling and tracking manufacturing processes in factories. The two companies signed a one-year study agreement to explore the market and a two-year agreement to design software and networking applications. No terms of the agreements, reached Tuesday, were disclosed.

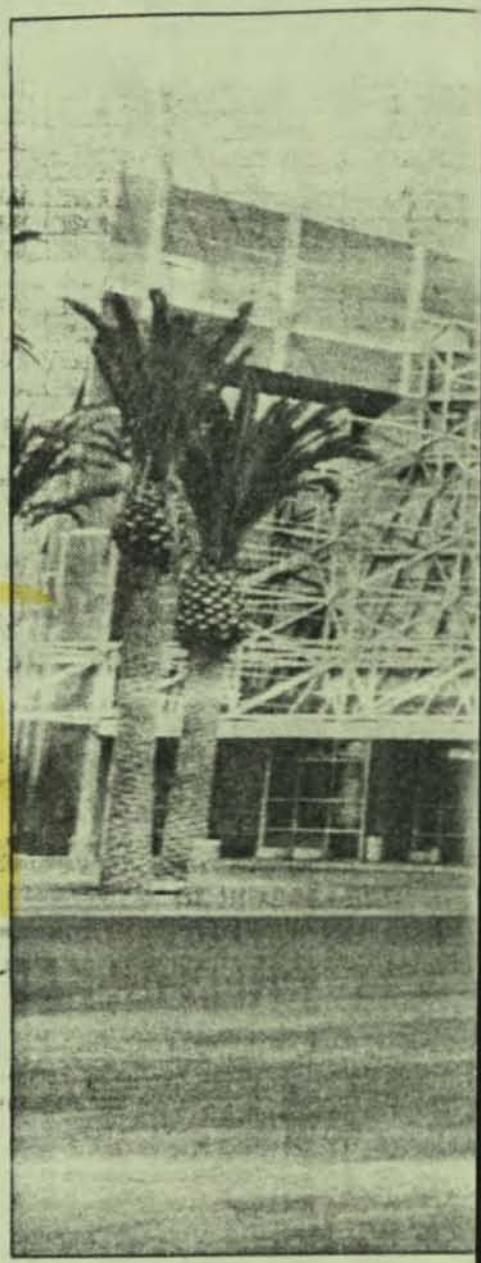
DELTA HAS SKYWEST OPTION: Delta Air Lines Inc. was granted on Wednesday an option to buy a 20 percent stake in Skywest Airlines Inc., an alliance that can inhibit a takeover of the St. George, Utah-based carrier and improve its financial strength. Skywest entered into a pact with Atlanta-based Delta because it already was a connecting carrier with Los Angeles-based Western Airlines. Delta bought Western for $860 million in December and will complete its acquisition April 1.

INSIDER-TRADING PENALTIES RAPPED: Judges came under sharp attack Wednesday for imposing only light sentences on defendants in Wall Street's insider-trading scandal and thus for sanctioning greed and fraud in the financial community. All of the convicted conspirators in the Dennis B. Levine insider-trading case "should have received much longer prison sentences than these judges seem willing to grant," U.S. Attorney Rudolph Giuliani told a forum on insider trading in New York.

MCI STREAMLINES CALLING: MCI customers in California next month will be the first MCI customers in the country to place MCI credit card calls at pay phones without first dialing lengthy local access and authorization codes. In California, 893 Pacific Bell Select-A-Carrier credit card phones, in major airports and hotels, have been programmed to receive the new cards and provide instant access to the MCI network.

COOPER-DEVELOPMENT SELLS DIVISION: Cooper Development Co. of Palo Alto announced Wednesday its affiliate, Cooper Technicon Inc. has agreed to sell its worldwide industrial systems business to Alfa-Laval AB for approximately $51 million, primarily in cash. The industrial systems business of Cooper Technicon has annual sales of approximately $50 million and markets near-infrared spectroscopy.

High-tech



Executive director Harvey H

4 months before i

By Kirstin Downey
Mercury News Business Writer

It's a concept ahead of its time, skept
flop just like the other ones, the naysay

But Techmart, the new high-tech ma
educational showcase close to complet
Clara, refused to die. In a market wher
buildings sometimes sit vacant for n
year, Techmart developer Kimball Sr
that Techmart is now 50 percent to
leased, with nearly 40 tenants signed
months before its official grand openin

"It's finally starting to get easy," sai
began planning the project in 1982. "
ants) starting to call us."

Techmart tenants and exhibitors
American Electronics Association, the

LEVEL 1 - 2 OF 3 STORIES

February 10, 1987, Tuesday

DISTRIBUTION: Business Editors

LENGTH: 471 words

HEADLINE: TANDEM/BOEING; (TNDM)(BA) Tandem Computers and Boeing Computer Services sign agreements

DATELINE: CUPERTINO, Calif.

BODY:

Tandem Computers Inc. (OTC:TNDM) and Boeing Computer Services Co., a division of The Boeing Co., Seattle, announced Tuesday that they have signed agreements to develop a comprehensive business relationship between the two companies.

The agreements, aimed at manufacturing and networking applications, were signed at BCS headquarters in Bellevue, Wash., by BCS president, Robert L. Dryden, and Tandem president and CEO, James C. Treybig. No financial terms of the agreements were disclosed.

The agreements have as their intent the integration of each company's products into comprehensive computer solutions for the manufacturing and network markets. Among the applications to be evaluateD are document handling, shop floor control and advanced cell control systems.

Gerald L. Peterson, Tandem vice president of marketing, said, ''The manufacturing industry is an important market opportunity for Tandem. In the process of factory automation, today's manufacturer can use on-line information for the control and integration of corporate business planning with plant operations.

''This relationship between Tandem and Boeing will help to determine and ultimately produce comprehensive on-line manufacturing solutions to achieve that integration.''

Additionally, Boeing will assist Tandem users in implementing custom networks and large on-line transaction processing applications on their Tandem NonStop computer systems.

To accomplish this, Boeing will provide services that include project management, design and development of application software solutions, support and education, and the integration of BCS products with those supplied by other vendors.

According to Alvin M. Savio, vice president of BCS Commercial Services Group, ''On-line processing for control of the factory floor and networks is one of the fastest growing markets in the data processing arena.

''The combination of Tandem computer systems and networking capabilities with BCS software products and services will result in superior offerings.''

Boeing Computer Services Co., headquartered in Bellevue, is a division of The Boeing Co. offering a complete range of information processing services. The address is P.O. Box 24346, Seattle 98124-0346, MS 7A-16.

Tandem Computers Inc. manufactures and markets computer systems and networks for on-line transaction processing. The company is located at 19333 Vallco Parkway, Cupertino 95014. The telephone number is 408/725-6000.

Tandem and NonStop are trademarks of Tandem Computers Inc.

CONTACT: Tandem Computers Inc., Cupertino
Joyce Strand, 408/725-6516
or
Boeing Computer Services Co., Bellevue
Ken Linarelli, 206/865-6391

LEVEL 1 - 3 OF 3 STORIES

February 10, 1987, Tuesday, BC cycle

SECTION: Regional News

DISTRIBUTION: Oregon, Washington

LENGTH: 210 words

HEADLINE: Tandem, Boeing announce joint computer agreement

DATELINE: SEATTLE

KEYWORD: Tandem

BODY:

Boeing Computer Services Co. and Tandem Computers Inc. of Cupertino, Calif., announced Tuesday an agreement to jointly produce computer programs and provide services for the manufacturing industry.

Financial terms of the agreement were not disclosed.

Under the agreement, the two companies will produce computers and programs for the handling of documents, shop floor control and advanced cell control systems, Boeing aand Tandem said.

''The manufacturing industry is an importaant market opportunity for Tandem,'' said Gerald Peterson, Tandem vice president for marketing. ''In the process of factory automation, today's manufacturer can use on-line information for the control aand integration of corporate business planning with plant operations.''

The Boeing computer company, a subsidiary of The Boeing Co. aerospace firm, will provide users of the Tandem Nonstop computer system with services including project management, design and development of software, and combining Boeing products with those from other vendors, officials said.

''The combination of Tandem computer systems and networking capabilities with BCS software products and services will result in superior offerings,'' said Alvin Savio, a Boeing Computer Services vice president.

LEVEL 1 - 1 OF 4 STORIES

Business Wire

February 9, 1987, Monday

DISTRIBUTION: Business Editors & Computer Writers

LENGTH: 490 words

HEADLINE: TANDEM; (TNDM) Tandem announces national language support for electronic mail product

DATELINE: CUPERTINO, Calif.

BODY:

Tandem Computers Inc. (OTC:TNDM) announced Monday availability of eight additional languages for its PS MAIL electronic mail product, opening up European markets and providing worldwide communications for multinational companies in the United States.

Introduced in 1985, PS MAIL is a distributed electronic mail system that provides easy-to-use electronic communications among users of a wide variety of desktop devices, including IBM 327x, conversational, or TTY terminals, IBM PCs or compatibles, and Tandem 653x terminals and DYNAMITE and 6AX workstations. PS MAIL is built on TRANSFER information delivery software first shipped by Tandem in 1983.

The enhancement adds presentation services for PS MAIL in Danish, Finnish, French, German, Hebrew, Norwegian, Spanish, and Swedish, enabling users to interact with PS MAIL in their own national languages. More than one language version can exist within a network of Tandem NonStop systems or on a single Tandem system, and users of different versions can exchange messages.

National-variant terminals are used to correctly display accented and other special characters. Where PS MAIL is used internationally, an accenting scheme allows the use of these characters in user names, even where a national terminal cannot display international characters.

Chris Erickson, Tandem director of software product management, commented, ''Many of our U.S. customers use PS MAIL as a productivity tool. National language support will allow Tandem to aggressively market PS MAIL in countries outside the United States.''

National language support for PS MAIL is available now for German, Hebrew, Norwegian, and Swedish; and in April 1987 for Danish, Finnish, French, and Spanish. Support for additional languages can be provided to meet future requirements.

National language support is provided at no additional charge to users of PS MAIL. PS MAIL is free to TRANSFER licensees for use with Tandem terminals and workstations; and with IBM PCs and compatibles connected to Tandem NonStop systems using Tandem PC LINK software.

PS MAIL for 327x and TTY terminals has an initial license fee of $2,000 (US) per system for NonStop II, TXP, and VLX systems, and $1,000 (US) for EXT

systems, plus a per system monthly license fee of $200 (US) for NonStop II, TXP, and VLX systems, and $100 (US) per EXT system.

Tandem Computers Inc. manufactures and markets computer systems and networks for the on-line transaction processing marketplace. The company is headquarted at 19333 Vallco Parkway, Cupertino, 95014. Phone is 408/725-6000.

CONTACT: Tandem Computers Inc., Cupertino
Tom Waldrop, 408/725-7191

LEVEL 1 - 2 OF 4 STORIES

Business Wire

February 9, 1987, Monday

DISTRIBUTION: Business Editors, Computer Writers

LENGTH: 606 words

HEADLINE: TANDEM-2; (TNDM) Tandem announces batch processing management tools.

DATELINE: CUPERTINO, Calif

BODY:

Tandem Computers Inc. (OTC/TNDM) Monday announced NetBatch and NetBatch Plus batch processing software for Tandem NonStop systems.

NetBatch is a scheduler for batch jobs that gives system managers and operators the ability to automate batch job execution on a Tandem system or across a network of Tandem systems. Batch jobs can be scheduled according to job priority, system load, and network configuration. NetBatch software also keeps a log of batch activity. ''NetBatch allows users to make more productive use of their Tandem systems by allowing users more flexibility and control over where and when they want to run their batch jobs, anywhere in the Tandem network,'' said Dennis L. McEvoy, Tandem vice president of software. ''This product also helps to speed processing of batch jobs by taking advantage of the Tandem system architecture. Tasks can be broken into several jobs and run simultaneously in different system processors,'' McEvoy said.

NetBatch is designed for on-line transaction processing users who need batch or sequential processing to print invoices, perform database searches, or generate reports that summarize business activity.

Users can access and work with data anywhere in a Tandem network and have either decentralized or centralized management of job scheduling in this network. Automatic execution and monitoring of batch jobs lets users focus on other activities, while still having the choice of responding to or intervening in certain stages of the job execution process.

NetBatch Plus Package

For users who want the advantages of NetBatch and who require some additional functionality and a full-screen user interface, Tandem is offering NetBatch Plus. This package bundles NetBatch software with DB BATCH FE, a batch front-end product from MIS Information Systems Inc.

MIS Information Systems Inc., of San Jose, Calif., is an Independent Software Vendor (ISV) for Tandem through the Tandem Alliance program. DB BATCH FE is a menu-driven interface that helps guide users through the job scheduling process. The interface accomodates very complex batch environments, yet allows even non-data processing professionals to run batch jobs.

Pricing and Availability

NetBatch and NetBatch Plus are available in the second quarter of calendar year 1987. DB BATCH FE is available now.

Prices below are given in U.S. dollars. NetBatch is priced at $2,700 Initial License Fee (ILF), with a $200 Monthly License Fee (MLF) for NonStop VLX, TXP, and II systems; and $1,350 ILF with a $100 MLF for NonStop EXT, EXT10, and EXT25 systems.

NetBatch Plus, the package containing NetBatch and DB BATCH FE is priced at $3,700 ILF, with a $340 MLF for NonStop VLX, TXP, and II systems; and at $1,850 ILF, with a $170 MLF for NonStop EXT systems. DB BATCH FE is priced separately at $2,700 ILF, with a $200 MLF for NonStop VLX, TXP, and II systems; and at $1,350 ILF, with a $100 MLF for NonStop EXT systems.

Tandem Computers manufactures and markets computer systems and networks for on-line transaction processing. The company is headquartered at 19333 Vallco Parkway, Cupertino, Calif. 95014. Phone is 408/725-6000.

CONTACT: Tandem Computers Inc., Cupertino
Corinne DeBra, 408/725-7574

LEVEL 1 - 3 OF 4 STORIES

Business Wire

February 9, 1987, Monday

DISTRIBUTION: Business Editors

LENGTH: 504 words

HEADLINE: TANDEM-3; (TNDM) Tandem Computers announces ISV agreement with MIS Batch

DATELINE: CUPERTINO, Calif.

BODY:

Tandem Computers Inc. (OTC/TNDM) Monday announced that DB BATCH FE batch processing front-end software and three other batch processing products from MIS Information Systems Inc., San Jose, Calif., have been certified by Tandem as Independent Software Vendor (ISV) products.

The DB BATCH FE user interface, BATCH PLUS, RM BATCH PLUS and DB BATCH PLUS, as part of the Tandem Alliance ISV program, will be jointly marketed and supported by Tandem and MIS as extensions to the Tandem product line. DB BATCH FE is an optional, menu-driven interface that can be used with Tandem NetBatch batch processing software, or can be purchased bundled with NetBatch, as NetBatch Plus.

Tandem NetBatch software is a scheduling system for batch jobs that runs on a Tandem system or across a network of Tandem systems. The MIS batch interface helps to guide users, step-by-step, through the job scheduling process.

Under the terms of the agreement MIS Information Systems Inc. will also market BATCH PLUS, RM BATCH PLUS, and DB BATCH PLUS (a package made up of RM BATCH PLUS and DB BATCH FE) directly to NonStop system users under the sponsorship of the Tandem Alliance, a program that encourages the development of software solutions for Tandem users.

Tandem Computers manufactures and markets computer systems and networks for on-line transaction processing. The company is headquartered at 19333 Vallco Parkway, Cupertino, Calif., 95014. Phone is 408/725-6000.

MIS Information Systems Inc., a California Corp., is located at 100 Homeland Ct., San Jose, Calif., 95050. Phone is 408/292-4244. Developed by MIS Information Systems, DB BATCH FE, BATCH PLUS, RM BATCH PLUS and DB BATCH PLUS are available for all NonStop systems, and can be ordered now.

Tandem NetBatch and NetBatch Plus will be available in the second calendar quarter of 1987.

Pricing

All prices below are given in U.S. dollars. DB BATCH FE is priced separately at $2,700 Initial License Fee (ILF), with a $200 Monthly License Fee (MLF) for NonStop VLX, TXP and II systems, and at $1,350 ILF with a $100 MLF for NonStop EXT systems.

NetBatch Plus is priced at $3,700 ILF with a $340 MLF for NonStop VLX, TXP and II systems; and at $1,850 ILF with a $170 MLF for NonStop EXT systems. NetBatch is priced separately at $2,700 ILF, with a $200 MLF for NonStop VLX, TXP and II systems; and at $1,350 ILF with a $100 MLF for NonStop EXT systems.

BATCH PLUS is priced with an ILF starting at $750 for NonStop EXT systems; RM BATCH PLUS is priced with an ILF starting at $1,350; DB BATCH PLUS is priced with an ILF starting at $1,850.

Tandem, NonStop, NonStop VLX, NonStop TXP, NonStop II, NonStop EXT, NonStop EXT10, NonStop EXT25, and NetBatch are trademarks of Tandem Computers Inc.

MIS, MIS BATCH, DB BATCH FE, BATCH PLUS, RM BATCH PLUS and DB BATCH PLUS are trademarks of MIS Information Systems Inc.

CONTACT: Tandem Computers Inc., Cupertino
Corinne DeBra, 408/725-7574

LEVEL 1 - 1 OF 12 STORIES

PR Newswire

February 25, 1987, Wednesday

DISTRIBUTION: TO CITY DESK

LENGTH: 449 words

HEADLINE: RICOH BALLOONS WILL CARRY CAMERA PRIZES

DATELINE: LOS ANGELES, Feb. 25

KEYWORD: RICOH BALLOONS TO CARRY PRIZES OVER LOS ANGELES MARATHON

BODY:

LOS ANGELES, Feb. 25 /PRN/ -- When the Los Angeles marathon runs on March 1, 1987, there will be 25 people who will literally receive cameras from heaven.

Ricoh Corporation, a major photographic manufacturer and office equipment company and a marathon sponsor, will release some 25,000 balloons to mark its 25th anniversary as well as the countdown one minute before the start of the race. Twenty-five of the balloons will carry coupons, good for a free Ricoh ''point and shoot'' automatic 35 mm camera.

In addition, all of the 20,000 runners expected to compete in the Los Angeles Marathon will be wearing Ricoh bibs, and the first three finishers -- both male and female -- will receive Ricoh cameras as prizes.

Ricoh is also providing copier and facsimile equipment for the marathon organizers, and 100 employees from Ricoh's California branches will serve as volunteers to help in the race activities.

This will be the second year of Ricoh's participation in the Los Angeles Marathon and the first year in which prize-carrying balloons will be released.

The Los Angeles Marathon, one of the country's leading sports events, was first run in 1986, when it drew nearly 11,000 runners.

In addition, the race will serve as the United States Corporate Athletics Association Championships. It will get underway at 9 a.m. on March 1.

The course winds through the city of Los Angeles, a 26.2-mile route passing through a variety of ethnic and culturally diverse areas. The route will include Chinatown, Little Tokyo, Olvera Street and Hollywood, and will finish in front of the Coliseum.

The importance of the marathon is reflected in its sponsorship. Presenting sponsors are Mercedes-Benz of North America and the Los Angeles Times, while sponsors include Ricoh, Coca-Cola, Tandem Computers, Sears Savings Bank, AT&T, Breyers and Eastman Kodak.

Ricoh's participation in the marathon is based on the value of promoting sports as an aid to physical fitness and the popularity of marathons. In addition, running as a sport is easily accessible to everyone since it does not require expensive equipment or special facilities.

Ricoh Corporation is based on West Caldwell, N.J., with branches in Irvine, Gardena, Santa Clara and San Jose, Calif. It is a major manufacturer of cameras and lenses, as well as one of the world's

largest producers of copiers. Ricoh also manufactures facsimile products and sophisticated electronic products.

CONTACT -- Emil Florio of Ricoh, c/o Biltmore Hotel, 213-624-1011, or Cindy Scully of Jean Doynow Associates, 212-213-0200, for Ricoh

Tandem, Syntech Sign Mktg. Pact

CUPERTINO, Calif. — Tandem Computers Inc. has signed a value-added reseller agreement with Syntech International Inc., Reno, Nev., to market its NonStop VLX and EXT processors as part of an on-line lottery system.

Syntech will bundle its player- and clerk-activated terminals, video lottery terminals and application software with the Tandem systems to form the lottery system, dubbed Marathon II.

Syntech will market and sell Tandem's top-end VLX system for high-volume transactions and the low-end EXT systems for low-volume transactions.

The Marathon II will be available in the third quarter of 1987, Tandem said.

Electronic News
2/23/87 p23

Reminder: the following is now overdue.

Author	Title	C
Davies, D	Security for Computer Networks, An Intro	

First Notice_____ Second Notice_____ THIRD & FINAL NOTICE_____

Another user is waiting to check this out_____

Please return this to the Corporate Information Center (3-07) within the next fe

Thank you.

Barbara Nepple
Technical Assistant,
Information Centers
(408)725-7121
\tsii.library.barbara
Nepple_Barbara

If you feel this request is in error - do not ignore it! Your department will b

**NOTE: Please advise us if borrower is away for an extended period, or has left T

ComputerWorld
2/23/87 p 24

NEW PRODUCTS

Systems software

Tandem Computers, Inc. has announced **Netbatch** and **Netbatch Plus**, batch processing software for its Nonstop systems.

Netbatch is a scheduler for batch jobs said to allow users to automate batch-job execution on a Tandem system or across a network of Tandem systems. Batch jobs can be scheduled according to job priority, system load and network configuration. Netbatch also keeps a log of batch activity.

Netbatch Plus bundles Netbatch software with DB Batch FE, a batch front-end product from MIS Information Systems, Inc. Together, they accommodate complex batch environments and provide a full-screen user interface.

Netbatch costs from $1,350 to $2,700 for an initial license with a monthly fee of $100 to $200. Netbatch Plus costs from $1,850 to $3,700 with a monthly fee of $270 to $340.

Tandem Computers, 19333 Vallco Pkwy., Cupertino, Calif. 95014.

Applications packages

Precision Visuals, Inc. has ported its **DI-3000 XPM**, **GK-2000** and **Picsure Plus System** graphics software packages to Digital Equipment Corp.'s Vaxstation II/GPX graphics workstations running under DEC's VMS.

The software is said to take advantage of the window and display-list functionality of DEC's UIS interface, including window resizing under control of an applications program and two-dimensional image transformations. Other hardware functions supported include 14 fonts, polygon fill, 10 line styles and 256 simultaneous colors.

Pricing is $9,000 for DI-3000 XPM; $3,500 for GK-2000; and $4,600 to $6,600 for the Picsure Plus System.

Precision Visuals, 6260 Lookout Road, Boulder, Colo. 80301.

Maxway Data Corp. has announced **Version 3.0** of its **Book Publishing Order Fulfillment** software.

Version 3.0 is said to allow name and address updates from the order-entry screen.

The order-entry screen also allows scrolling of inventory items by ISBN num-

According to the vendor, other a
butes of the integrated software pacl
include full-overlay windows that a
the user to view and manipulate dat
the spreadsheet, graphics display
word processing document simultane
ly.

The Dynasoft package also include
pop-up menus that are said to prompt
user.

The Dynasoft Integrated Software
System is priced from $17,500
$49,000, depending on the size of
computer.

Dynasoft, Suite 500, 6300 River R
Rosemont, Ill. 60018.

INSIDE

February 23, 1987
Issue 105

InformationWEEK®

A CMP PUBLICATION

COVER STORY/ISSUES & TRENDS

TO RUSSIA WITH LOVE

Computers from Big Blue are finding their way into Red Square, and not always legally. A look at how profiteers make millions by supplying the Soviets with the latest Western technology from various vendors.

40

Cover photo: Tass from Sovfoto

SECTIONS

SEQUENT'S GIMBLE AND SIMON 30

MARTIN STEIN OF PAINE WEBBER 33

LETTERS

InformationWEEK

by CMP Publications, Inc.
600 Community Drive, Manhasset, NY 11030
(516) 365-4600

Publisher/Editor-In-Chief
E. Drake Lundell Jr.

Managing Editor
Dennis Eskow

Assistant Managing Editor
John J. McCormick

Senior Editors
Tom Ewing
Paul E. Schindler Jr.
Robert H. Blissmer

Senior New England Editor
Robert S. Buday (617) 237-5588

West Coast Editor
Juli Cortino (408) 252-6191

Chief Copy Editor
Nancy Houghtaling

Associate Editors
Diana ben-Aaron
Richard Layne

Assistant Editors
Michelle Louzoun
Jerome D. Colonna

Contributors
W. David Gardner
Philip J. Gill
Arthur J. Tobias
R.D.R. Hoffmann
Lee Green
Ted Francis
Michael Fillon
Ellen Messmer

Copy Editor
Albert S. Leibs

Correspondents
Tokyo: Janice Kawamoto
London: Philip Hunter

Production Editor
Dale Anderson

Editorial Secretary
Patricia Whalen

Art Director
Hector W. Marrero

Associate Art Director
Debbie L. Weinkauff

President
Gerard G. Leeds

Senior Vice President
L.J. Leeds

Vice President/Group Publisher
Thomas L. Cooper

Editorial Director
Al Perlman

informationWEEK (ISSN 8750-6874) is published weekly, except for a double issue for the last two weeks in December, by CMP Publications, Inc., 600 Community Drive, Manhasset, NY 11030. G.G. Leeds, President, L.J. Leeds, Senior Vice President and Pearl Turner, Treasurer.

InformationWEEK is free to qualified management and professional personnel involved in the information systems industry. Subscription rates for all others in the U.S. and Canada are $65.00 for one year. Overseas air mail rates are: Mexico and Central America, $155.00 for one year; Europe and South America, $195.00 for one year; Asia, Africa and Australia, $210.00 for one year. Mail subscriptions with check or money order to Circulation Dept. For renewals or change of address, please include the mailing label appearing on the front cover.

POSTMASTER: Send address changes to InformationWeek, 600 Community Drive, Manhasset, NY 11030.

Address all inquiries, editorial copy, advertising or subscriptions to InformationWeek, 600 Community Drive, Manhasset, NY 11030. Second Class Postage paid at Manhasset, NY and additional mailing offices.

Tape Cleaning Device Predicted

I found the "3480 Tape Cleaning: Still A Messy Issue" article in the January 12 issue informative, and I agree with most of your points.

However, the inference could be drawn that tape cleaning is not very important. It is safe to assume that the leading suppliers of magnetic media will soon supply a cleaning device.

G.W. Wetzel
Director of Marketing
Graham Magnetics Inc.
North Richland Hills, Texas

Footage Method On Right Track

About your January 12 article, "3480 Tape Cleaning: Still a Messy Issue." It sure is, especially if you are involved in the recall and "wet washing" of your 3480 tape units.

I agree with Jim White's statement that IBM needs to go beyond measuring footage to provide an adequate cleaning program, but it is progress when compared to the old Eleventh Commandment: "Thou shalt clean the tape drives every four hours (whether needed or not)."

Pat Riziello
President
Tape Library Consulting
Yardville, N.J.

Request For Company Index

Please consider adding an index by company to your magazine. I have found this a most helpful tool in other publications. Quite often it means the difference between which periodical is read and which is tossed aside.

Maria H. Jones
Management Project Analyst
Arkansas Dept. of Health
Little Rock, Ark.

While we are not currently indexed, the idea is being explored.—Ed.

Reminder On Wang's Laptop

I found it ironic that you printed Richard H. Di Vecchio's letter ("Praise, Concern For Wang Labs") in the same issue as your Product Focus on laptop PCs ("Product Focus: Laptop PCs: Business Catches The New Wave," January 26, page 25). Mr. De Vecchio complained that you were short-changing your readers by ignoring Wang, or any other important vendor. Yet your article failed to even mention the Wang LapTop.

William L. Principe Jr.
Wang Laboratories Inc.
Los Angeles

Would You Believe Artistic License?

Concerning your "Thinking Big, Thinking Small" Miscellany item on page 33 of the January 26 issue: I was shocked to see a picture of an IBM PC substituted for one of an Apple computer in the illustration accompanying your article. The PC is not able to support the "advanced thought processes" that distinguish the Macintosh and its brethern.

Timothy S. Oey
Information Center Analyst
Fidelity Systems Co.
Boston

Tandem Ships Thin-Film Media

An article referring to recent announcements by Digital Equipment Corp. ("Other Products That DEC Announced, And Some That It Didn't," January 26) states that "no major vendor has yet shipped thin-film disk media in production volume."

The Tandem XL8 disk-storage facility, introduced in October 1985, incorporates nine-inch disk drives that employ thin-film media. The Tandem XL8 has been shipping in high volume for nearly 18 months.

Derek Ginger
Product Manager
Storage Products
Tandem Computers Inc.
Cupertino, Calif.

InformationWEEK welcomes any suggestions, comments, or ideas from readers. Send letters to: *InformationWEEK*, 600 Community Drive, Manhasset, N.Y. 11030. Include your name, title, and company's address and telephone number. We'd like to hear from you.

Tandem, Boeing Unit in Auto. Alliance

CUPERTINO, Calif. — Tandem Computers Inc. and Boeing Computer Services Co. (BCS) have agreed to explore jointly the development of manufacturing automation systems, while giving Boeing authorization to develop networks for Tandem customers.

Under a 1-year agreement, BCS and Tandem will explore ways in which Tandem's computer systems and BCS software can be integrated to provide automated document handling, shop floor control and advanced cell control systems. If Tandem and BCS decide to proceed, BCS might port some of its existing software to Tandem computers and/or develop new software for the systems, said Sandy Vanderhyde, manager of alliances for BCS. The two firms are also exploring the possibility of jointly marketing the products.

BCS now offers Project Management System software on IBM 370 systems and Hewlett-Packard 3000 computers, and AXXYZ CAD /CAM software on IBM 370 systems, Digital Equipment Corp. VAX VMS systems, Apollo and, by the end of the year, on Sun workstations.

Under a separate 2-year agreement, BCS will become a Tandem "solutions implementer," authorized by Tandem to design networks for its customers. BCS will focus on developing networks for manufacturing applications. Tandem has similar agreements with Westinghouse and Arthur Young.

The financial terms of the two agreements were not released.

The agreement between Tandem and Boeing follows one signed last fall between BCS and Scientific Computer Systems, Wilsonville, Ore., under which the two firms are developing software for Scientific Computer's Cray-compatible processors and will jointly market the products (EN, Sept. 15, 1986). BCS and Scientific Computer Systems have sold five systems within BCS parent firm The Boeing Co., and five systems to outside firms, said Willie C. Aikens, director of the executive program for BCS.

Electronic News
2/23/87 p23

Reminder: the following is now overdue.

Author	Title	C
none	Security and Privacy, 1985 Proceedings	

First Notice_____ Second Notice_____ THIRD & FINAL NOTICE_____

Another user is waiting to check this out_____

Please return this to the Corporate Information Center (3-07) within the next fe

Thank you.

Barbara Nepple
Technical Assistant,
Information Centers
(408)725-7121
\tsii.library.barbara
Nepple_Barbara

If you feel this request is in error - do not ignore it! Your department will b

**NOTE: Please advise us if borrower is away for an extended period, or has left T

LEVEL 1 - 1 OF 2 STORIES

February 24, 1987, Tuesday, Home Edition

SECTION: Sports; Part 3; Page 1; Column 1; Sports Desk

LENGTH: 840 words

HEADLINE: TAILING MARATHON'S ORDINARY PEOPLE

BYLINE: By TRACY DODDS, Times Staff Writer

BODY:

It has been more than 13 years since she ran track for UCLA, and even then she certainly wasn't a superstar. There were some big names on that team, but Kit Kakadelas wasn't one of them.

Now, a marriage and six children later, Kit Brazier doesn't expect to threaten the leaders when she runs in Sunday's Los Angeles Marathon, either. Her best marathon time is 3 hours 29 minutes.

So imagine her surprise when race organizers asked her to come to the Biltmore Hotel last week to be honored as one of several runners to be dubbed Race Aces.

At the luncheon, she picked up a trophy and, more important, a yellow racing singlet that will identify her as a Race Ace and allow KCOP-TV to track her over the marathon course.

The idea is to get some up-close-and-personal stories on common runners, people the average jogger can identify with.

KCOP is working closely with Tandem computers on a system that will provide up-to-the-minute information on where the elite runners, and selected other runners, are on the course at all times. Tandem has installed a data center in the KCOP studios and has also designed a graphics program that will appear on the TV screen.

The computers will also be able to provide the TV commentators with marathon background and biographical information on any runner.

As entries were received, facts and figures were fed into the computers. That information has been pulled back out in different forms, giving race officials demographic charts that show how many of the runners are men, or women, are married, what states and countries are represented, which professions and corporations are represented, what kind of educational backgrounds and marathon experience the runners represent.

The system also sought out the Races Aces and picked Kit Brazier as "Supermom."

No doubt there will be some TV viewers more impressed to see a 34-year-old woman of six children, all under 8, run a good pace and finish the marathon than they would be to see a world-class runner run a record time.

Brazier has run in 12 marathons and two ultra-marathons -- 50 miles -- doing all her training between 5:30 a.m. and 7 a.m.

"I have to be back by 7, because that's when my husband leaves for work," Brazier said.

Her two oldest boys sometimes run with her, but they really can't do the kind of distance she does.

The kids think it's great that their mom is the Supermom and that she'll be on TV. As she talks about her childrens' reactions, Brazier passes around a snapshot of the family -- a whole string of cute little blond kids. Her personal fan club.

All of the Race Aces, though, will have their own fan clubs.

Terrie Brown, "The Fastest Waitress," expects a lot of support from her co-workers at the Rusty Pelican. She's a more recent graduate of UCLA, where she also competed for the track team. Brown, who is engaged to former UCLA linebacker Doug West, will probably have some Bruin backers, too.

Lots of folks will be rooting for Bill Lowry, "The Fastest Postal Employee," and August Simien, "The Fastest Fire Fighter."

Some may even be praying for Jimi Calhoun, "The Fastest Clergyman."

Bill Ezpeleta appeared at the luncheon with his biggest fan, Emily. Actually, she goes along for the ride, which is why her dad was named "The Baby Stroller."

Everyone was interested to see Leroy King, "The Runner With the Most Legs." He turned out to be a dog. But he is an official entrant, and he'll be wearing his own yellow singlet.

The list goes on and on. Some are running just for fun, others quite seriously.

Connie McCarthy, "The Fastest Homemaker," has a best time of 2:57. And Hal Stern was named "Most Optimistic Runner" because he listed his best marathon time as 6 hours 30 minutes and his expected time as 4 hours.

Race promoters joked that they might change his title to "Biggest Liar" if he doesn't come close to 4 hours.

KCOP Producer Phil Olsman explained the concept and the logistics to the Aces. He asked them to go out of their way a little bit to give a wave or a yoo-hoo to the spotters who will be reporting the progress of the leaders so that the Aces will be charted, too.

He said that newscaster Wendy Rutledge would be on the course, riding with a video camera. "If you're moseying along Sunset, stop by and see Wendy," he said.

"I don't want to hurt your chances for a personal best or anything, but if you're working on a four- or five-hour marathon, take a moment. I'm interested in anything from 'Don't talk to me now, I'm dying out here,' to 'Say hi to the wife and kids.' "

KCOP is going to be televising, live, for four hours and will do an hour wrap-up later that evening. So there will be time for looking back in the pack for the common runner.

Olsman said: "TV people have a tendency to ignore pack runners. What we're hoping to do here is to make you, the unique runner, as much a part of the show as the elite runner.

"This is not a national show, it's a local show. We want you local runners on.

"If you help us out, and if God is good to us, it will work."

THIS WEEK'S PRODUCTS

NO-STATIC WRISTBAND FROM OHM/ELECTRONICS

The Anti-Static Wrist Strap, from Ohm/Electronics, fits on a user's wrist and prevents the transfer of static electricity, which is damaging to microcomputer chips and circuits.

The user wraps the band around his wrist; the band is then attached to an antistatic chip that is placed on the work surface. The product comes in small, medium, and large sizes. Priced at $14.95, it is available now.

Ohm/Electronics Inc., Palatine, Ill. 60067; (800) 323-2727

TANDEM'S NONSTOPS GET CONTROLLER

Tandem Computers has introduced the 6106ACC, a VLSI-based communications controller for its line of Non-Stop computers. The controller consists of a board that fits into a processor cabinet and communications software for the computer itself.

The controller can link a host computer to up to 16 asynchronous remote devices such as printers and terminals. Dual ports on the 6106ACC connect to the I/O channels of two processors on the main computer, providing a back-up system in the event that one of the processors fails. Available during the first quarter of 1987, the controller is priced at $5,760.

Tandem Computers Inc., Cupertino, Calif. 95014-2599; (408) 725-6000

DATA COMMUNICATIONS

AMERICAN MITAC MODEMS NOW MADE FOR PCs

American Mitac has released the Mitac 1200H and 1200D, internal and external modems compatible with IBM's PC, PC/XT, and PC AT. In addition, the 1200D is also compatible with the Apple Macintosh.

Both products can transfer data at rates of 300 or 1,200 bauds per second and feature either touch-tone or rotary dialing as well as self-diagnostic tests. In addition, the products come with the PC-Talk III communications package, the Official Airline Guide, a bulletin board of flight information, and People Link, an electronic mail service. They are priced at $149 each, and come with a one-year warranty.

American Mitac Corp., Santa Clara, Calif. 95054; (408) 988-0258

AST PICKS FOUR MODEMS FOR APPLE COMPUTERS

Now available from AST Research are four modems for the Apple Macintosh and Macintosh Plus personal computers with data transfer rates ranging form 300 to 1,900 bauds per second.

The low-end model, the AST 1200, transmits data at 300 or 1,200 bps. Priced at $499, this modem features automatic dial, automatic answer, and a built-in speaker. The AST 2400, priced at $699, has a 300-to-2,400 baud rate, and comes with a built-in telephone directory. The third modem, the AST-2X2400, lists for $899 and has a 300-to-4,800 baud rate.

The AST-2X9600 works at a variety of speeds ranging from 300 to 19,000 bps and contains the Class 6 MNP standard, which allows it to communicate with other modems regardless of their transmission rates. It is priced at $1,899. All four modems are available now and come with two-year warranties.

AST Research Inc., Irvine, Calif. 92714; (714) 863-1333

ERROR-CORRECTING MODEM ADDED TO ACCESS SERIES

Gandalf Data has added an error-correcting modem to its Access Series line of dial-up modems.

The Access Series 24V is a 2,400-bit-per-second modem with automatic dialing capabilities that include a 400-character multiple-dial recall, last-number redial, automatic redial, and alternate-number redial. Available now in either standalone or rackmount versions, the models list for $695 and $650, respectively.

Gandalf Data Inc., Wheeling, Ill. 60090; (312) 541-6060

OFFICE SYSTEMS

UNISYS HAS PRINTER FOR MAINFRAMES

A high-speed impact-band printer, the B9246-24, has been developed by Unisys for its A, V, and 900 Series of mainframe computer systems.

The Unisys Band Printer, which features print speeds of up to 2,000 lines per minute, is available now for $48,000, while a monthly leasing fee on a five-year agreement, including 24-hour maintenance, is $2,715.

Unisys Corp., Detroit, Mich. 48232; (313) 972-7000

STAR MICRONICS RELEASES FIVE DOT-MATRIX PRINTERS

The N series from Star Micronics is a line of five dot-matrix printers that are compatible with the IBM PC. The printers contain touch-pad control panels that allow users to execute printing commands without software or DIP switches.

Star's top-of-the-line printer, the NB24-15, prints 180 characters per second in draft mode and 60 cps in letter-quality mode. It is priced at $1,099. The four remaining printers can print drafts at speeds ranging from 240 cps to 100 cps and near-letter-quality forms at rates varying from 60 cps to 25 cps. Prices range from $279 to $799. All five printers are available now.

Star Micronics Inc., New York, NY 10166; (212) 986-6770

NEC DOT-MATRIX PRINTER IS IBM-COMPATIBLE

NEC Information Systems has released the Pinwriter Model P9XL, a 24-wire dot-matrix printer that is compatible with the IBM PC. It has a mean-time-between-failure rate of 7,000 hours.

Forms produced by the P9XL have a resolution of 360-by-360 dots per inch. Draft copies are generated at a rate of 400 characters per second and final forms are produced at a speed of 140 cps. The printer comes with six resident fonts and an optional ribbon that can produce eight colors. Available now, the Pinwriter is priced at $1,695; the multicolored ribbon can be purchased for $14.

NEC Information Systems Inc., Boxborough, Mass. 01719; (617) 264-8000

DATACOPY LINKS FAX TO IBM PC

Datacopy has introduced a facsimile communications product, called MicroFax, which consists of a circuit board and software program for the IBM PC; it is available now for $1,195.

With MicroFax, the user can run a word processing or spreadsheet program and communicate with a fax machine at the same time. The product features automatic send and receive, as well as store-and-forward memory for broadcasting and automatic dialing. The MicroFax modem can transmit a page in 30 seconds, and a second modem operates at 1,200 bits per second for ASCII transmission.

Datacopy Corp., Mountain View, Calif. 94043; (415) 965-7900

Tandem Computers Inc. - Company Report
FIRST BOSTON CORPORATION (THE) - Peterson, M.S.
10-23-86 (RN=614519)

We want to buy and own Tandem stock. While the stock has done well since the spring, we believe that it could work higher as the company maintains its current momentum and completes its marketing reorganization. The strong projected growth for the on-line transaction processing market and Tandem's ability to hold its own against new entrants make this an attractive holding for a technology portfolio.

Recent Price:	37 1/2(a)
DJIA:	1808.4
S&P 400	262.2
Price Range:	
52 Weeks	39 1/2-14 1/2
Earnings Per Share (b):	
1987E	$2.00
1986E	1.40
1985A	0.82
P/E Ratios:	
1987	18.7X
1986	26.8
Indicated Dividend:	--
Yield:	--
Average Shares Outstanding (mil):	43
NASDAQ Symbol:	TNDM
Market Value	1.61 bil.
Book Value/Share	$10.10
L.T. Debt as % Total Capital	4.9%
Return on Avg. Equity	8.2%
Est. Future EPS 5 Yr. Growth Rate	17%

(a) As of the close, October 22, 1986.
(b) Fiscal year ends September 30.

Summary and Recommendation: Buy

We want to buy and own Tandem Computers Inc. (TNDM) stock. While the stock has done well since the spring, we believe that it could work higher as the company maintains its current momentum and completes its marketing reorganization. The strong projected growth for the on-line transaction processing market and Tandem's ability to hold its own against new entrants make this an attractive holding for a technology portfolio.

Fiscal 1986

Fiscal 1986, ending September, is the year that Tandem completed its transition from a lucky start-up to a mature company positioned for a more competitive world. The firm introduced new high- and low-end systems as well as a bevy of supporting products, finished rationalizing its manufacturing and distribution operations, started deriving products from its new design center, and won several highly publicized large contracts.

At a time when the overall industry continued its 1985 sluggishness, Tandem's good news shone even brighter in comparison. We project that total sales for fiscal 1986 could close at $762 million, up 22% from fiscal 1985's $624 million. We look for an earnings per share increase of 69% to $1.40 versus fiscal 1985's $0.82.

The company's fiscal 1986 pretax margin could rise from 9.0% to 14.3%. We base our estimate on a six-percentage-point drop in cost of goods sold as Tandem's more efficient product design and streamlined manufacturing leverage stronger sales. R&D spending could stay flat as a percentage of sales despite new software and communication programs as the firm takes advantage of the FAS #86 accounting change to capitalize software expenses.

Offsetting stronger gross margins could be a one-and-a-half-percentage-point advance in marketing, general and administrative costs. This reflects Tandem's restructuring of its marketing organization to sell larger, integrated systems and to expand indirect sales. With little change in the impact of interest income, the result of these sales and margin trends might be a 93% increase in pretax income.

Tandem's tax rate is expected to increase from 39% to 44.5% and the number of shares could rise to 43.5 million from 41.8 million. These lead us to our projected fiscal 1986 earnings per share of approximately $1.40, up 69% from fiscal 1985's $0.82.

Fiscal 1987 and 1988

We believe that Tandem is well positioned for an increase in equipment revenues in fiscal 1987 and 1988 even if the computer industry's health remains lackluster. Barring a major boom or collapse in the economy, the major components of Tandem's growth could be the growing demand for on-line transaction processing solutions, acceptance of Tandem's integrated applications for this market, the expansion of its indirect sales partners and joint ventures, and the emerging image

in the minds of Fortune 500 MIS directors of Tandem as a mature company with staying power.

Adding these opportunities together, we arrive at a possible 23% revenue increase for Tandem in fiscal 1987 to $935 million. With this continued revenue growth, Tandem may earn a pretax margin of 16.0% versus fiscal 1986's 14.3%. With a lower tax rate and larger share base, this margin expansion could translate into $2.00 earnings per share, up 43% from fiscal 1986's $1.40. Possible fiscal 1988 results could be a 24% revenue gain to $1.16 billion, with earnings per share of $2.25-2.35.

Long Term

Tandem's sales growth for the fiscal 1986-1991 period could be 20-22% compounded annually. The on-line transaction processing market is projected to grow faster than the general-purpose system market, perhaps at 18-20% versus 12-14% per year, as the declining cost per transaction opens up the unsaturated opportunity of new customers and new applications. We expect Tandem to moderately outperform the overall OLTP market with its emphasis on integrated applications and indirect sales channels.

Tandem's pretax margins could grow less rapidly, perhaps at a 16-18% rate annually, as the competition for on-line transactions processing (OLTP) applications heats up. Since the general-purpose market has matured into a more cyclical business in the 1980s, the larger vendors like DEC, NCR and IBM can no longer afford to ignore a big, steadily growing niche like OLTP. Although we believe the market underestimates Tandem's ability to sell against these giants, their presence could aggravate pricing pressures. We estimate a pretax margin around 12.5% in fiscal 1990 versus fiscal 1986's estimated 14.3%.

Tandem Computers Profile

Tandem was founded in 1974 in Silicon Valley's younger days when everything seemed possible with the right market niche, some seed money, a few good engineers and a strong tailwind of double-digit growth. In this environment, Tandem excelled as one of the most successful Silicon Valley start-ups by touching all the bases: backing from the supercharged Kleiner, Perkins venture fund, some hot engineers from Hewlett-Packard, and a plum of a market niche: on-line transaction processing (OLTP).

The 1960s wave of general-purpose minicomputer companies addressed the broadest possible markets by focusing on power and price. However, price/performance considerations alone do not meet the needs of an OLTP application. For a bank transferring funds, an airline taking reservations or a manufacturer monitoring stock levels, the cost per transaction can be secondarily important to fault tolerance or 100% "up" time, fast response time, data security, and access to branch locations. Meeting these needs requires complexity and redundancy which, if executed with hardware at 1970s prices, would have been

multi-million dollar solutions. Instead, Tandem adopted a combined hardware and software approach to OLTP and dominated the niche.

Tandem's niche was further enriched by IBM's early restraint in pursuing it. Under its decade-long antitrust siege, IBM protected its mainframe business with less aggressive behavior in other markets. Since IBM's architectures weren't designed for fault tolerance anyway, IBM deemed it wise to sell near-solutions and cede true OLTP applications to Tandem.

Tandem's performance from fiscal 1977 through fiscal 1982 reflected the successful development of its opportunity: 108% annual revenue growth to $312 million, earnings growth to $50.9 million for a 16.3% operating margin, an enviable list of Fortune 1000 clients in financial services, manufacturing, point-of-sale, and transportation, and legendary employee loyalty celebrated at weekly get-togethers. But times changed. The economy weakened, IBM settled its antitrust suit to become more aggressive, more competitors entered the business, and Tandem faced the margin pressures of loose cost controls and overexpansion.

The result of these tougher times showed though clearly: 28% revenue growth between 1982 and 1985, earnings growth of only 5% over the same period, and a revenue recognition problem with the SEC. As management undertook the necessary financial controls, product introductions, and facility consolidations, their optimism for the impact of these actions aggravated Tandem's reputation as a company that promised $1.20 earnings per share and delivered $0.80.

Near-Term Outlook

Today, Tandem has emerged from its transition trough to position itself as a more mature company in a more competitive world. The company has implemented four of the five steps it deemed necessary to resume its earnings growth and stay on its customers' short lists:

* Broadened its image past its fault tolerance roots to capitalize on IBM's weakness in networking and distributed data bases.

* Completed its CAD, simulation, and wafer fabrication facility to shorten product cycles and stay competitive with considerably richer vendors.

* Improved the sizzle that sells the steak -- the quality of the supporting products which customers require with the high-end systems. For Tandem, the sizzle includes an application generator, better peripherals, communications hardware, hardware-based service capabilities, and a competitively priced low-end product.

* Rationalized its manufacturing and distribution operations to reflect a centralized manufacturing approach and a slower growing customer base.

The fifth area targeted for improvement, a marketing and sales reorganization, is not a completed story in fiscal 1986. However, the impact of Tandem's other efforts could deliver record sales and earnings in fiscal 1986: a possible fourth quarter close of $215 million in revenues for $0.43 earnings per share to finish fiscal 1986 with a 22% increase in revenues to $762 million and earnings per share of $1.40, up 89% over fiscal 1985's $0.82.

Along with our analysis of probable trends in the major parts of the company's business, we include below an examination of possible changes in Tandem's cost components, pretax earnings, and earnings per share. The tables at the end of this report contain a detailed pro forma profit and loss statement, results by business segment, and other financial information.

Stand-Alone Applications

(57% of estimated fiscal 1986 sales) -- Since Tandem offers a family of on-line transaction processing systems sold to all its end markets, its business segments break best along marketing and sales line: how the Tandem system fits into a customer's overall computer strategy and who is the primary sales contact between the customer and the product. With this understanding, we have divided Tandem into four segments: stand-alone applications sold by Tandem's own sales force, integrated applications sold directly, indirect sales, and service.

The stand-alone applications launched Tandem in 1974. Since Tandem's combined hardware and software approach to fault tolerance made the systems expensive as general-purpose minicomputers, its customers were those who viewed OLTP as a primary and critical application worth the price. Examples include an automatic teller machine or electronic funds transfer package for a bank, a reservation system for an airline, a trading network for a stock exchange, or a manufacturing control system.

Since these functions could be automated as stand-alone tangents, Tandem could sell into accounts dominated by IBM or other vendors without upsetting on-going automation plans. This niche commitment to coexistence yielded Tandem 1,000 customers, many in the industrial and service Fortune 500. For fiscal 1986, we would expect Tandem's revenues to break out along these end markets:

Financial services	32%
Manufacturing	15
Tele-communications	13
Retail/ Wholesale	10
Federal government	8

Transportation	7
Publishing/ Printing	5
Medical	5
Other	5-10

To assure that the system would have 100% availability or "up" time, Tandem's engineers built modular units, each with its own microprocessor-based central processing unit (CPU), memory, and operating system. This approach requires a lot of memory and saps some of the processor power, but it avoids the vulnerability of one shared memory failing.

We estimate that this group may exhibit an 8% revenue increase in fiscal 1986 to $435 million. Since Tandem has served this market for over ten years, it is more saturated and depends on a better economy for upgrades to get funded. Furthermore, Tandem's modularity makes it an expensive solution for low-end stand-alone applications because each unit increase in the system's capabilities represents a large outlay. Stratus Computers, Tandem's most direct competitor, has combined good application packages with a different hardware approach to steal $57 million of this segment in the first six months of calendar 1986. With sluggish market demand and capable competition, we would expect the pretax margin of this segment to be below the corporate average.

Integrated Applications

(9% of estimated fiscal 1986 sales) -- As revenues slowed during the 1982-1985 period, Tandem's management analyzed what its competitive strengths were. Tandem's combined hardware and software approach had become vulnerable to competitors who claimed to offer lower costs-per-transaction on unbundled systems. However, Tandem's architecture offered networking and distributed data base capabilities that are strongly competitive and less widely recognized.

To increase the visibility of these features, Tandem introduced a rewrite of its Guardian operating system in May 1985 which sharpened these communications features. The updated system better enables Tandem to integrate its transaction processing applications with existing applications or incompatible systems. For example, Wells Fargo expanded its automatic teller network into a retail delivery network, Safeway Stores tied together its order processing and warehousing, and J.C. Penney is tying its point-of-sale systems at its 800 retail stores back to headquarters.

A second critical part to Tandem's pursuit of integrated applications was the April 1986 introduction of its new high-end system, the Nonstop VLX. This system, with a base price around $1 million, has twice the performance, three times the reliability, and half the maintenance cost of its predecessor, the Nonstop TXP.

To link the VLX to installed equipment, Tandem offers a host of industry standard networks including SNAX, an IBM mainframe bridge which is often cited as superior to IBM's own SNA. Tandem also offers

EXPAND, network software which allows 255 geographically dispersed locations to be interconnected with distributed processing. With this level of networking power and reach, Tandem can support the multiple locations, systems, and applications customers are shouting to tie together.

Since integrated applications tend to be larger projects sold to larger companies as part of a strategic overhaul, this segment is not particularly sensitive to the capital spending or MIPS saturation. Fiscal 1986 is the first year we would separate this segment for Tandem, for it is the first full year that the new VLX with the rewritten operating system was available and that the marketing organization was sufficiently reworked to focus on the opportunity. We look for revenues from this group to double in fiscal 1986 to roughly $70 million with margins above those of the stand-alone applications market.

Indirect Sales

(14% of estimated fiscal 1986 sales) -- The computer industry slowdown of the last two years has sent all the vendors scurrying for incremental sources of revenues. Everyone simultaneously rediscovered the strength of software houses which write software specifically for your hardware and third-party vendors who package your hardware with their software to reach customers your sales force wouldn't reach otherwise. In this spirit, Tandem started its Alliance program in 1985 to better focus on its 225 indirect partners.

To attract and keep this incremental business, Tandem developed two new products: the EXT10 and EXT25. Their predecessor, the EXT, had been introduced only ten months earlier, but had been faulted by some Alliance members as too expensive and slow. The new EXT10 came out with a slight 7.5% power improvement and a 35% price cut to $100,000 and is better positioned to help the indirect channel sell to price-sensitive and smaller users. The EXT25, with 2.5 times the power of the EXT10, provides users with the necessary upgrade path.

Since the EXT10 and EXT25 were introduced only in August 1986, they will have little impact on this segment's performance in fiscal 1986. However, we expect this group to grow a healthy 35% to roughly $105 million in fiscal 1986, growth which reflects the ability of application packages or "solution selling" to survive budget cuts and modest capital spending plans. Since Tandem's indirect channel relationships include all of its products sold in various combinations, we look for margins in this area to be at that of the overall firm.

Service

(20% of estimated fiscal 1986 sales) -- Like all other large computer vendors, Tandem's revenue is derived from two sources: equipment and service. Service includes not only hardware repairs and maintenance but also documentation, training, and software maintenance. With a new product cycle at its high and low ends and a new version of

its operating system, Tandem had many opportunities to increase its service revenue through upgrades and add-on business in fiscal 1986.

We project that service revenues could expand 42% in fiscal 1986 to $155 million. This surprising strength in service during a time when Tandem's base business was still feeling the effects of a rough economy is expected to play a key role in providing the incremental revenue which catapults Tandem out of its three-year earnings slump. Although gross margins for service often look slim when the accountants are done allocating labor costs, the pretax margins of service are nicely unburdened by R&D or selling expenses. We would expect margins in this area to be measurably above the corporate average.

International

(38% of estimated fiscal 1986 sales) -- Tandem's sales abroad have traditionally lagged its more general-purpose competitors who moved abroad earlier to avoid the heated domestic competition. However, the slowdown which focused Tandem on integration and indirect channels also led to an expansion of the firm's international presence. An expanded European sales staff and weakened dollar could produce a solid 51% boost in European revenues to $205 million, or 27% of total revenues. The "other" segment includes Canada, the Far East, Asia, and Latin America and could reflect some favorable currency moves for a 24% revenue gain to roughly $87 million, or 12% of total revenues.

Pretax Profit

The industry-wide softness in computer orders which has hung over Tandem throughout its fiscal year could have been an unmitigated disaster for the company in its older, wilder days. However, the slower growth that the company encountered in 1982-1985 prepared Tandem for this different world. Management's renewed commitment to seeking incremental revenue beyond its base business and to controlling costs so that they lag rather than anticipate growth is likely to pay off in a major way in fiscal 1986: projected record pretax income of $109 million, a 93% increase over fiscal 1985's $56.4 million. This represents a pretax margin of 14.3% versus 9.0%, a real triumph in a mixed economic and technological environment.

The estimated changes in cost components are as follows:

Cost of Goods Sold -- (32.1% of estimated fiscal 1986 sales) -- A major contributor to Tandem's previous earnings problems was the company's attempt to regionalize manufacturing. By the start of fiscal 1986, Tandem had undone the damage and centralized into two primary plants in Cupertino, one in Munich, and a terminal facility in Austin.

With this kind of consolidation, any revenue growth can cause measurable margin improvement. In fiscal 1986, we anticipate that cost of goods sold as a percentage of sales could finish at 32.1%, or $245 million, a 2% increase over fiscal 1985's $240 million. or 38.5% of sales.

Another key factor in Tandem's 67% gross margin is the company's approach to sourcing its components. Rather than backward integrate into semiconductors and disk drives like many of the general-purpose vendors, Tandem outsources most of its components, becoming more of a systems integrator than a vertically integrated manufacturer. The modularity of Tandem's system allows for a high degree of component commonality across its product line and good volume discounts.

Research and Development -- (11.3%) -- The stream of new products that Tandem has introduced over the last four quarters is the result of major, ongoing R&D programs. The firm has pursued three programs simultaneously: the new VLX and EXT hardware introductions, the operating system and software products aimed at expanding the uniqueness of Tandem's OLTP architecture, and the inter-vendor communication protocols which the Fortune 500 and federal government are demanding -- MAP, LU6.2, DISOSS, SNA, IEEE 802.3.

In addition, Tandem's efforts to minimize development time for new products and deliver new products to market faster has led to the development of an in-house computer-aided design, simulation, and VLSI prototype fabrication facility. The expense of building these tools was incurred primarily between 1981 and 1985, but its impact was strong in 1986: the company estimates that VLX design time was reduced a year with these aids. CAD tools not only quicken design times but lead to more effective designs which require less hardware and help Tandem achieve its 67% gross margin.

This broad spectrum of development projects is expected to keep R&D spending above 11% of sales, up from historic levels of around 9%. Our estimated 21% increase to $86 million is roughly even with revenue growth only because of the FAS #86 accounting change in fiscal 1986 which permitted Tandem to capitalize nearly $5 million of its software development costs.

Marketing, General and Administrative -- (43.4%) -- The tight control with which Tandem seized its manufacturing and R&D operations is still not fully effected in its marketing organization. Tandem's development of integrated applications and indirect channels required a rebalancing of its selling approach. Ideally, the firm would like to free-up its direct sales force to work with big accounts on integration possibilities and leave smaller, stand-alone applications to its indirect channels.

To achieve this, Tandem restructured its sales staff into seven regions and is looking to add industry experts in its target integration markets -- banking, airlines, manufacturing, etc. -- in each region. This shifts the focus from products to end markets. To further encourage development of the new opportunities, Tandem this spring announced that for the first time it would permit its Alliance members to compete head-to-head with its direct sales for some stand-alone applications.

We see MG&A increasing 28% to $330 million in fiscal 1986 as Tandem implements this reorganization.

Interest Income, Net -- (1.1%) -- With only $7 million in long-term debt and capitalized lease obligations and a cash balance of $180 million, Tandem is in a solid cash position. Therefore, we expect this item to remain a net contribution for the foreseeable future.

Pretax Income -- (14.3%) -- Based on this analysis, we believe that Tandem can earn $109 million in fiscal 1986, up 93% from fiscal 1985's $56.4 million.

Taxes and Fiscal 1986 Earnings Per Share

Tandem's tax rate in fiscal 1986 will be higher than fiscal 1985's 39% principally from lower R&D tax credits and higher profits. We estimate a 44.5% tax rate for fiscal 1986.

With the share base increasing from 41.8 million to an estimated 43.5 million, we look for fiscal 1986 to yield earnings per share of approximately $1.40, a 69% increase from fiscal 1985's $0.82.

Fiscal 1987 and 1988

Tandem appears well-positioned for accelerating revenue growth in fiscal 1987. Although we expect the economy to maintain moderate growth based on First Boston's projection of roughly a 2% GNP increase, we do not believe that the general economy is the principal engine behind Tandem's momentum. Barring a major collapse or boom in the economy, the major determinant of Tandem's success could be the acceptance of its integrated applications, the growth of its Alliance partners and joint ventures, and the emerging image of Tandem as a mature company with staying power.

In the area of integrated applications, Tandem's 1986 advantage of having a shippable product and reformed sales mentality should extend into 1987. IBM's high-end OLTP solution, the TPF system based on a 3080 mainframe, is inflexible, difficult to program, a challenge to connect to other equipment and locations, expensive to expand, and unlikely to be changed much in fiscal 1987.

Although no one is supposed to want to compete with IBM in the mainframe business, Tandem's high-end system with its superior data base and communications features provides an easy comparison with IBM mainframes. In contrast, its low-end system with its expensive software redundancy provides a much tougher comparison with Stratus and IBM minicomputers. Customer satisfaction ratings of IBM mainframes, minicomputers, and Tandem are displayed in Figures 1-6 and show that for many criteria, customers are happier with their Tandem system than their IBM mainframe but like their IBM minicomputer even better.

Another competitor mentioned as a Tandem-spoiler in fiscal 1987 is Digital Equipment. DEC recently announced a joint venture with L.M.

Ericsson to provide integrated applications to telecommunication companies. However, the joint venture is only being staffed now and unlikely to rampup in fiscal 1987. In terms of other OLTP applications, the DEC VAX cluster does offer high availability but is not tailored for transaction processing and does not guarantee data recovery. Although DEC's announced intentions for the OLTP market might slow down some buyers, we believe that DEC's short-term impact on Tandem's revenue growth will be small.

Now that Tandem has introduced a more competitive low-end system, we expect further growth from its indirect channels. Many of Tandem's Alliance relationships have been established in the last 18 months. The combination of new products and greater familiarity could start to be a real winner in fiscal 1987.

A positive for Tandem in fiscal 1987 which is intangible but we expect to be measurable is its emerging image as a mature company and major player. The kind of boom year which Tandem is expected to complete in 1986 not only rewards the shareholders but makes it easier for MIS directors to keep Tandem on their supplier short list along with IBM and DEC. The addition of Walter Wriston, retired chairman of Citicorp, to the board of directors furthers Tandem's staying power in the minds of its Fortune 500 customers.

Adding these opportunities, we arrive at a 23% revenue increase for Tandem in fiscal 1987. This represents a 20% increase in equipment revenues to $730 million and a 32% service gain to $205 million. With this continued revenue growth, Tandem may earn a pretax margin of 16.0%, compared with 14.3% in fiscal 1986. This margin expansion could translate into $2.00 earnings per share, up 43% from fiscal 1986's $1.40. Possible fiscal 1988 results could be a 24% revenue gain to $1.16 billion, with earnings per share of $2.25-2.35.

Long Term

Tandem's sales growth for the fiscal 1986-1991 period could be 20-22% compounded annually. The OLTP market is projected to grow faster than the general-purpose system market, perhaps at 18-20% versus 12-14% per year, as the declining cost per transaction opens up the unsaturated opportunity of new customers and new applications. We expect Tandem to moderately outperform the overall OLTP market with its strengthening emphasis on integrated applications and indirect sales channels.

Tandem's pretax margins could grow less rapidly, perhaps at a 16-18% rate annually, as the competition for OLTP applications heats up. Since the general-purpose market has matured into a more cyclical business in the 1980s, the larger vendors can no longer afford to ignore any big, steadily growing niche like OLTP. At the low end of the market, start-ups can capitalize on hardware advances to introduce cheap, fast solutions. These pricing pressures are aggravated by customer demands for industry standards which are costly to develop but necessary to stay on users' "short lists" of suppliers.

We would expect earnings per share to grow roughly at the same rate as pretax earnings as Tandem's tax rate drops but the firm's equity base expands. Below we explore the components of Tandem's long-term growth model and summarize those projections in Table 6.

Stand-Alone Applications

The part of Tandem's business where we expect it to feel the most competitive heat over the next five years is in its original market of stand-alone applications. As the cost per transaction drops for OLTP and expands sales of these products to less critical applications, the customers are likely to become more price sensitive. So, we look for part of the heat on Tandem to be external: the continued pursuit by other companies of market share with better price/performance stories -- in particular, Stratus Computers.

Stratus learned from Tandem's early success and has focused on tangential applications which can coexist with IBM at financial services companies and with DEC at manufacturing concerns. Good application packages, technically elegant hardware, and an OEM relationship with IBM deliver to Stratus sales which would otherwise be Tandem's core business. From an estimated revenue base of $200 million in 1987, Stratus could grow to as much as $500 million by 1991. -

There are also several start-ups and smaller companies counting on low-cost hardware solutions to fault tolerance to open up the low end of the market: Parallel Computers, Sequoia Systems, No Halt Computers, Concurrent Computers, and Arete Systems. The failure of two other start-ups, Auragen Systems and Synapse Computers, underlines the technical difficulties of delivering on fault-tolerant promises. However, the aggressiveness of these new entrants may accelerate price declines.

Another part of Tandem's competitive pressures in this segment is internal. The firm's marketing reorganization is aimed at selling nationally with fewer salespeople calling at a higher level in the target accounts. This is an effective approach for capturing new business and bigger projects, but by default deemphasizes direct sales of add-on packages to installed customers. The long-term growth of Tandem's indirect channels reflects in part a shift in how the company delivers stand-alone applications.

We therefore estimate that Tandem's revenues in this segment may grow 8% compounded annually. We look for pretax margins to increase 2% annually to 9.4%, three percentage points below the corporate average of 12.6%, as Tandem cuts price to protect its installed base.

Integrated Applications

Tandem management points to this segment as the firm's biggest opportunity for the rest of the 1980s. Stand-alone solutions may be broadening into less critical applications, but the firms looking to integrate their transaction processing applications with their other automation programs are the ones for whom OLTP is their "crown jewel"

or key competitive factor: financial services, transportation, point-of-sale, telecommunications and manufacturing.

Tandem has a three-to five-year window to capitalize on the juncture of three events: its good history in stand-alone applications with these target clients, its networking and communications capabilities, and IBM's current weakness in delivering an integrated solution at the mainframe performance level. Other large companies making the same bet are DEC, NCR, EDS, HP and IBM.

For the telecommunications and manufacturing end markets, DEC is the general-purpose vendor of choice. lt has years of experience tying together pieces of the factory floor and phone companies' back and front offices. To improve customer awareness of itself as an alternative to DEC in these markets, Tandem has established several relationships:

* a minority investment in Integrated Technologies, a start-up researching ways to handle a phone company's central switching as a transaction processing application;

* a minority investment in Triplex, a start-up working on a link in the computer-integrated manufacturing (CIM) chain;

* separate joint ventures with Rockwell and Arthur Young in the CIM arena;

* a joint marketing program with Indiana Bell for service order entry software;

* a marketing agreement with Altos Computers to sell UNIX, AT&T's operating system, on Tandem hardware;

* an agreement with AT&T to be a licensee for DMI, or Digital Multiplexed Interface, the standard for the integration of PBX equipment into a Tandem network.

We expect Tandem to make headway in both end markets despite DEC's enormous presence. DEC's current solution for transaction processing is neither cheap nor thorough, and any improvements along these dimensions create a marketing conflict with DEC's existing products. Although DEC will continue to announce its commitment to OLTP, companies which want it now will look at Tandem.

NCR created a splash by introducing an OLTP system, the 9800, in 1986. We see this as a defensive move unlikely to make major inroads into Tandem's VLX sales, since anything Tandem does to strengthen its ability to sell into IBM mainframe environments inevitably makes it easier to sell into BUNCH accounts. HP is gunning for the CIM market with its new RISC-based series, but we believe the next five years will find HP feeding its installed base before it pursues big, integrated automation projects. EDS and GM are expected to be a major force in the CIM area, but Tandem's investment in MAP, GM's efforts to dictate a lingua franca on the factory floor, prepare it to follow where EDS and

GM lead.

Tandem's biggest competitor for integrated applications is IBM. With an R&D budget that could exceed $7 billion in 1986, IBM presumably has the technological capabilities to offer better OLTP and communications products. That IBM hasn't is support for the argument that IBM is run by and for the sales force -- what sales staff likes to damage long-term client relationships by offering something which compares too favorably with an older product the client bought a short time before? With this argument in mind, we do not believe that IBM will threaten its 3080 and 3090 sales with a hot high-end OLTP product in the foreseeable future.

Therefore, we see Tandem's integrated applications sales growing at perhaps 47% per year from fiscal 1986's small base. The bigger and more critical nature of these projects could deliver 13.5% pretax margins, representing compounded growth of 40%.

Indirect Sales

As competitors and a strategic shift point Tandem to the high end of the market, the firm looks to indirect channels to strengthen its presence at the low end. The appeal of reaching smaller customers through a third-party sales force recently prompted Tandem to contact 1,500 of DEC's resellers and software developers with a multi-media promotional push. This active pursuit of incremental revenues was not a major program for Tandem in the early 1980s, but we believe that it may combine with Tandem's direct sales of integrated applications to maintain the company's momentum for the next several years.

A spoiler could be IBM as the cash-rich giant tries to spend some money before the SEC accuses it of becoming a bank. One place IBM might spend its money is on third-party software houses, like its recent purchase of Hogan Systems, a leading banking software firm. Although this one deal does not undermine Tandem's Alliance program, IBM's gain in the indirect channels could be Tandem's loss, so this is an area we will watch closely for potential future threats.

Assuming no major defections among Tandem's current stable of third-party relationships, the addition of a few new ones, and an increase in sales per relationship as Alliance program members ramp up, we expect the company to grow revenues and earnings from this channel at roughly 30% per year off a small fiscal 1986 base. Our 13.7% pretax margin estimate is higher than the corporate average since these partnerships incur lower MG&A expense.

Service

Tandem's modular architecture, its accelerating rate of new product introductions, and its expanding application software base all create robust opportunities for field upgrades and new service contracts. Therefore, we estimate that Tandem's product revenues may grow 21% compounded annually over the fiscal 1986-1991 period. The

pretax margin of this segment -- 15.7% -- could be the highest in the firm, but is expected to fall from fiscal 1986's estimated 17.7% as third-party service organizations inject more pricing pressure.

Financials

Capital expenditures may approximate $50 million in fiscal 1986, including the exercise of a land option in San Jose. In fiscal 1987, Tandem's plans project the acquisition of some additional design tools and equipment for its prototype fabrication facility and the purchase of some buildings in the weak Silicon Valley real estate market. Capital spending could therefore climb to the $60-65 million range.

The analysis of Tandem's financial strength we show in Tables 7-10 reveals a company running under tight financial management. The nightmarish vacillations in cash and inventory which plagued Tandem in the early 1980s peaked with fiscal 1982's 303 days of inventories. The company's current $177 million in cash, 102 days inventory, 97 days payables, and 1% long-term debt to capitalization compare favorably with any industry participant, and we would not expect to much further improvement.

Management

James Treybig, pronounced try'-big, founded Tandem in 1974 after studies in electrical engineering at Rice University, a Stanford M.B.A., several years at Hewlett-Packard, and work with Thomas Perkins at Kleiner, Perkins, the venture fund. Mr. Perkins is still the chairman today, and Mr. Treybig remains the president and chief executive officer. They are supported by a management team which blends original employees with newer hires from IBM, HP and other established vendors. Robert Marshall, Senior Vice President. joined Tandem in 1975 from Xerox, and David Rynne, the chief financial officer, came on board in 1983 from Burroughs.

Unlike some of his Silicon Valley compatriots, Mr. Treybig professes no interest in starting another venture. Instead, he is challenged by the goal of leading Tandem past the $1 billion sales mark. The company's current senior team is expected to stay in place to assist in the quest, with the addition of incremental senior marketing staff with vertical marketing experience.

Acquisition Activity

Tandem is expected to continue more minority investments in the communications and applications software fields like its Triplex and ITI relationships. Its $180 million cash position would enable the firm to complete several smaller situations, but probably Tandem from reaching for one big acquisition like an established systems house.

Tandem's official position on being acquired is one of no interest. The firm has an anti-takeover defense in place that prevents an unfriendly, two-tier takeover, but the stock's recent rise accomplishes the same. As Tandem burrows deeper into the Fortune 500

with its integrated applications push, its premier client list could prove tempting to a Fujitsu or Siemens. We would not expect management to refuse the right global partner at an attractive price down the road, but we do not believe that Tandem would consider a major merger until the value of its marketing reorganization is more fully reflected in the stock price.

October 22, 1986, closing prices:

Altos (ALTO): 10 1/2
American Telephone & Telegraph (T): 23 5/8
Citicorp (CCI): 48 1/8
Concurrent (CCUR): 13 1/2
Digital Equipment (DEC): 96 7/8
L.M. Ericsson (ERICY): 37 1/8
Hewlett-Packard (HWP): 37 1/2
International Business Machines (IBM): 120 3/8
NCR (NCR): 45
J.C. Penney (JCP): 76 1/2
Safeway (SA): 60 3/8
Stratus Computer (STRA): 19 3/4
Well Fargo (WFC): 106
Xerox (X): 26 3/8

Table 1

Interim Operating Results
($ in millions, except per share data)

[Part 1 of 2]

Year	Net Sales	Pretax Income	Pretax Margin	Income Taxes
F1986				
First quarter	$170.0	$21.0	12.4%	$9.3
Second quarter	176.3	22.4	12.7	10.0
Third quarter	200.8	32.7	16.3	14.5
F1985				
First quarter	$159.7	$24.4	15.3%	$10.4
Second quarter	146.5	11.3	7.7	4.4
Third quarter	144.2	1.8	1.2	(0.5)
Fourth quarter	173.8	18.8	10.8	7.7
Year	$624.1	$56.4	9.0%	$22.0
F1984				
First quarter	$126.3	$18.0	14.3%	$7.9
Second quarter	111.2	3.1	2.8	1.2
Third quarter	141.9	15.6	11.0	6.4
Fourth quarter	153.1	19.6	12.8	7.7
Year	$532.6	$56.3	10.6%	$13.4
F1983				
First quarter	$94.1	$11.7	12.4%	$4.6
Second quarter	96.0	10.2	10.6	3.8
Third quarter	110.3	13.9	12.6	5.6
Fourth quarter	117.9	14.7	12.5	5.9
Year	$418.3	$50.5	12.1%	$19.7
% Increase (Decr.) F1986 versus F1985				
First quarter	6.4%	-13.9%		-10.3%
Second quarter	20.3	98.2		125.2
Third quarter	39.3	1716.7		NM
% Increase (Decr.) F1985 versus F1984				
First quarter	26.4%	35.6%		31.3%
Second quarter	31.7	264.5		270.1

Third quarter	1.6	(88.5)	(108.4)
Fourth quarter	13.5	(4.1)	0.1
Year	17.2%	0.2%	64.1%
% Increase (Decr.) F1984 versus F1983			
First quarter	34.2%	53.8%	71.7%
Second quarter	15.8	(69.6)	(68.4)
Third quarter	28.6	12.2	14.3
Fourth quarter	29.9	33.3	30.5
Year	27.3%	11.5%	-32.0%

[Part 2 of 2]

Year	Tax Rate	Net Income	Earnings Per Share
F1986			
First quarter	44.5%	$11.6	$0.28
Second quarter	44.5	12.4	0.29
Third quarter	44.5	18.1	0.40
F1985			
First quarter	42.5%	$14.0	$0.34
Second quarter	39.3	6.8	0.16
Third quarter	(29.9)	2.4	0.06
Fourth quarter	41.0	11.1	0.27
Year	39.0%	$34.4	$0.82
F1984			
First quarter	43.9%	$10.1	$0.24
Second quarter	38.7	2.0	0.50
Third quarter	41.0	9.2	0.23
Fourth quarter	39.3	21.6	0.53
Year	23.8%	$42.9	$0.81
F1983			
First quarter	39.3%	$7.1	$0.18
Second quarter	37.3	6.5	0.16
Third quarter	40.3	8.4	0.21
Fourth quarter	40.1	8.8	0.21
Year	39.0%	$30.8	$0.76
% Increase (Decr.) F1986 versus F1985			

First quarter	-17.1%	-17.6%
Second quarter	82.4	81.2
Third quarter	654.2	566.7
% Increase (Decr.) F1985 versus F1984		
First quarter	38.6%	41.7%
Second quarter	240.0	(68.0)
Third quarter	(73.9)	(73.9)
Fourth quarter	(48.6)	(49.1)
Year	-19.8%	1.2%
% Increase (Decr.) F1984 versus F1983		
First quarter	42.3%	33.3%
Second quarter	(69.2)	212.5
Third quarter	9.5	9.5
Fourth quarter	145.5	152.4
Year	39.3%	6.6%

Table 2

Possible F1986 and F1987 Results
($ in millions, except per share data)

[Part 1 of 2]

	Estimated			Actual	
	F1988	F1987	F1986	F1985	F1984
Equipment Sales	$895.0	$730.0	$607.0	$515.1	$448.6
Service Revenues	270.0	205.0	155.0	109.0	84.0
Net Sales	1,165.0	935.0	762.0	624.1	532.6
Less:					
Cost of sales	$368.0	$294.0	$244.5	$240.1	$215.7
Marketing, gen'l & admin	490.0	395.0	330.5	262.3	213.3
Research & devpmt	128.0	103.0	86.4	71.6	52.5
Interest income (net)	10.0	9.0	8.4	6.3	5.2
Pretax income	189.0	152.0	109.0	56.4	56.3
Income tax	$74.7	$61.5	$48.5	$22.0	$23.1
Effective tax rate	39.5%	40.5%	44.5%	39.0%	41.0%
Reversal of deferred taxes on DISC					$9.7
Net income	$114.3	$90.5	$60.5	$34.4	$42.9
Earnings per share before DISC	$2.30	$2.00	$1.40	$0.82	$0.80
Earnings per share after DISC					1.04
Average shares outstanding	49.2	45.8	43.5	41.8	41.4
Percent of Sales					
Equipment sales	76.8%	78.1%	79.7%	82.5%	84.2%
Service revenues	23.2	21.9	20.3	17.5	15.8
Cost of Sales	31.6	31.4	32.1	38.5	40.5
Marketing, gen'l & admin	42.1	42.2	43.4	42.0	40.0
Research & devpmt	11.0	11.0	11.3	11.5	9.9
Interest	0.9	1.0	1.1	1.0	1.0
Pretax income	16.2	16.3	14.3	9.0	10.6
After-tax income before DISC	9.8	9.7	7.9	5.5	5.8

[Part 2 of 2]

	% Change			
	F1988 versus F1987	F1987 versus F1986	F1986 versus F1985	F1985 versus F1984
Equipment Sales	22.6%	20.3%	17.8%	14.8%
Service Revenues	31.7	32.3	42.2	29.8
Net Sales	24.6	22.7	22.1	17.2
Less:				
Cost of sales	25.2%	20.2%	1.8%	11.3%
Marketing, gen'l & admin	24.1	19.5	26.0	23.0
Research & devpmt	24.3	19.2	20.7	36.4
Interest income (net)	11.1	7.1	33.3	21.2
Pretax income	24.3	39.4	93.3	0.2
Income tax	21.5%	26.8%	120.5%	-4.8%
Effective tax rate	(2.3)	(9.1)	14.1	-4.9
Reversal of deferred taxes on DISC				
Net income	26.3	49.6	75.9	(19.8)
Earnings per share before DISC	15.0	42.9	70.1	2.5
Earnings per share after DISC				
Average shares outstanding	7.4	5.3	4.1	1.0

Percent of Sales

Equipment sales
Service revenues
Cost of Sales
Marketing, gen'l & admin
Research & devpmt
Interest
Pretax income
After-tax income before DISC

Table 3
Possible F1986 and F1987 Results by Industry Segment

($ in millions)

[Part 1 of 2]

	Estimated		Actual	
	F1987	F1986	F1985	F1984
Sales				
Stand-Alone Applications	$463.0	$435.0	$404.0	$372.0
Integrated Applications	118.0	68.0	34.0	19.0
Indirect Sales	149.0	104.0	77.0	58.0
Service	205.0	155.0	109.0	84.0
Total	$935.0	$762.0	$624.1	$532.6
Pretax Income (estimates)				
Stand-Alone Applications	$68.0	$54.4	$30.0	$34.8
Integrated Applications	21.1	11.7	4.8	3.0
Indirect Sales	25.3	15.5	8.1	6.7
Service	37.6	27.4	13.5	11.8
Total	$152.0	$109.0	$56.4	$56.3
Pretax Margin				
Stand-Alone Applications	14.7%	12.5%	7.4%	9.4%
Integrated Applications	17.9	17.2	14.1	15.8
Indirect Sales	17.0	14.9	10.5	11.6
Service	18.3	17.7	12.4	14.0
Total	16.3%	14.3%	9.0%	10.6%
% of Total Sales				
Stand-Alone Applications	49.5%	57.1%	64.7%	69.8%
Integrated Applications	12.6	8.9	5.4	3.6
Indirect Sales	15.9	13.6	12.3	10.9
Service	21.9	20.3	17.5	15.8
Total	100.0%	100.0%	100.0%	100.0%
% of Total Pretax Income (estimates)				
Stand-Alone Applications	44.7%	49.9%	53.2%	61.8%
Integrated Applications	13.9	10.7	8.5	5.3
Indirect Sales	16.6	14.2	14.4	11.9
Service	24.7	25.1	23.9	21.0

Total	100.0%	100.0%	100.0%	100.0%

[Part 2 of 2]

	% Change		
	F1987 versus F1986	F1986 versus F1985	F1985 versus F1984
Sales			
Stand-Alone Applications	6.4%	7.7%	8.6%
Integrated Applications	73.5	100.0	78.9
Indirect Sales	43.3	35.1	32.8
Service	32.3	42.2	29.8
Total	22.7%	22.1%	17.2%
Pretax Income (estimates)			
Stand-Alone Applications	25.0%	81.3%	(0.14)
Integrated Applications	80.3	143.8	60.0
Indirect Sales	63.2	91.4	20.9
Service	37.2	103.0	14.4
Total	39.4%	93.3%	0.2%
Pretax Margin			
Stand-Alone Applications			
Integrated Applications			
Indirect Sales			
Service			
Total			
% of Total Sales			
Stand-Alone Applications			
Integrated Applications			
Indirect Sales			
Service			
Total			
% of Total Pretax Income (estimates)			
Stand-Alone Applications			
Integrated Applications			
Indirect Sales			
Service			
Total			

Table 4
Possible F1986 and F1987 Results by Geographical Segment
($ in millions)

	Estimated		Actual		% Change F1987 versus F1986	% Change F1986 versus F1985
	F1987	F1986	F1985	F1984		
Net Sales						
United States	$602.0	$465.0	$417.5	$364.9	29.5%	11.4%
Europe	238.0	210.0	136.3	109.6	13.3	54.1
Other	95.0	87.0	70.4	58.2	9.2	23.6
Total	$935.0	$762.0	$624.1	$532.6	22.7%	22.1%
Pretax Income						
United States	$96.0	$65.0	$34.4	$41.9	47.7%	89.0%
Europe	39.5	31.0	15.4	9.7	27.4	101.3
Other	16.5	13.0	6.5	4.7	26.9	100.0
Total	$152.0	$109.0	$56.4	$56.3	39.4%	93.3%
Pretax Margin						
United States	15.9%	14.0%	8.2%	11.5%	14.1%	69.7%
Europe	16.6	14.8	11.3	8.9	12.4	30.7
Other	17.4	14.9	9.2	8.1	16.2	61.8
Total	16.3%	14.3%	9.0%	10.6%	13.6%	58.3%
% of Total Sales						
United States	64.4%	61.0%	66.9%	68.5%		
Europe	25.5	27.6	21.8	20.6		
Other	10.2	11.4	11.3	10.9		
Total	100.0%	100.0%	100.0%	100.0%		
% of Total Pretax Income						
United States	63.2%	59.6%	61.0%	74.4%		
Europe	26.0	28.4	27.3	17.2		
Other	10.9	11.9	11.5	8.3		
Total	100.0%	100.0%	100.0%	100.0%		

Table 5
Estimated Growth in the F1986-F1991
Time Interval By Industry Segment

	Estimated 1991	Estimated F1986	Compound Growth Fiscal 1986 to Fiscal 1991
Sales			
Stand-Alone Applications	$650.0	$435.0	8.0%
Integrated Applications	465.0	68.0	47.0
Indirect Sales	380.0	104.0	30.0
Service	405.0	155.0	21.0
Total	$1,900.0	$762.0	21.0%
Pretax Income			
Stand-Alone Applications	$61.0	$54.4	2.0%
Integrated Applications	63.0	11.7	40.0
Indirect Sales	52.0	15.5	27.0
Service	64.0	27.4	18.0
Total	$240.0	$109.0	17.0%
Pretax Margin			
Stand-Alone Applications	9.4%	12.5%	
Integrated Applications	13.5	17.2	
Indirect Sales	13.7	14.9	
Service	15.8	17.7	
Total	12.6%	14.3%	
% of Total			
Stand-Alone Applications	34.2%	57.1%	
Integrated Applications	24.5	8.9	
Indirect Sales	20.0	13.6	
Service	21.3	20.3	
Total	100.0%	100.0%	
% of Total Pretax Income			
Stand-Alone Applications	25.4%	49.9%	
Integrated Applications	26.3	10.7	
Indirect Sales	21.7	14.2	
Service	26.7	25.1	
Total	100.0%	100.0%	

Table 6

Balance Sheet Data
($ in millions, except per share data)

	F1985	F1984	F1983	F1982	F1981	F1980
Working Capital						
Cash and Equivalent	$128.7	$106.9	$93.5	$24.8	$89.8	$16.2
Receivables	163.4	146.3	119.6	98.8	70.7	42.6
Inventories	79.0	92.4	85.9	101.4	54.5	20.9
Other expenses	14.3	7.0	11.8	17.0	5.0	2.0
Total current assets	$385.4	$352.6	$310.8	$242.0	$220.1	$81.7
Total current liabilities	$86.8	$89.2	$56.6	$47.2	$41.0	$20.4
Working capital	298.6	263.4	254.2	194.8	179.1	61.3
Current ratio	444.0%	395.3%	549.1%	512.7%	536.8%	400.5%
Sales/receivables	3.8	3.6	3.5	3.2	2.9	2.6
Sales/inventory	7.9	5.8	4.9	3.1	3.8	5.2
Capitalization						
Long-term debt	$12.4	$17.2	$24.0	$21.1	$2.1	$1.7
% of total capital	4.9%	4.4%	7.2%	7.8%	1.0%	2.4%
Shareholders' equity	$420.4	$375.1	$311.0	$251.0	$204.8	$70.3
% of total capital	95.1%	95.6%	92.8%	92.2%	99.0%	97.6%
Total capitalization	$432.8	$392.3	$335.0	$272.1	$206.9	$72.0
Average shares outstanding	41.8	41.4	40.8	39.2	37.0	30.2
Book value per share	$10.1	$9.1	$7.6	$6.4	$5.5	$2.3

Table 7

Source and Applications of Funds
($ in millions)

	F1985	F1984	F1983	F1982	F1981	F1980
Source						
Operations						
Net Income	$34.4	$42.9	$30.8	$29.9	$26.5	$10.7
Depreciation	35.6	22.7	18.8	10.2	4.1	2.5
Deferred liabilities	12.3	(3.5)	5.9	9.2	4.8	2.3

Total from operations	$82.3	$62.1	$55.5	$49.3	$35.4	$15.5
Increase (decrease) in short-term debt	$1.8	($25.7)	($13.3)	$7.1	($17.2)	($7.5)
Increase (decrease) in other assets	13.3	9.0	14.8	8.1	1.3	0.0
Sales of common stock (net)	10.9	21.2	29.2	16.3	108.0	28.1
Total	$108.3	$66.6	$86.2	$80.8	$127.5	$36.1
Application						
Capital expenditures	$67.6	$71.5	$42.2	$65.8	$27.2	$10.0
Reduction of long-term debt	12.7	(4.9)	(4.1)	(20.4)	(0.4)	(0.5)
Increase (decrease) in accounts receivable	17.0	26.8	20.7	28.1	28.1	22.7
Increase (decrease) in inventory	(13.4)	6.5	(15.4)	46.8	33.6	9.6
Increase (decrease) in cash and marketable securities	24.2	(33.3)	42.8	(39.5)	39.0	(5.7)
Total	$108.3	$66.6	$86.2	$80.8	$127.5	$36.1

Table 8

Estimated F1986-F1987 Cash Flow
($ in millions)

	F1987	F1986
Source		
Net Income	$91	$61
Depreciation	55	44
Other	6	5
Operations	$152	$110
Short-term debt (net)	$15	$5
Increase (decrease) in accounts payable	5	(5)
Sales of common stock (net)	40	35
Total sources	$212	$145
Application		
Capital Expenditures	$65	$50
Reduction of long-term debt	(3)	5
Increase (decrease) in accounts receivable	60	45
Increase (decrease) in inventories	15	(20)
Increase (decrease) in cash and marketable securities	75	65
Total application	$212	$145

Table 9

Empirical Return for F1981-F1985

	F1985	F1984	F1983	F1982	F1981
Revenue/Average total assets (asset turnover)	1.18	1.16	1.11	1.05	1.14
X					
Pretax income/Revenue (pretax margin)	0.07	0.09	0.12	0.11	0.14
=					
Pretax income/Average total assets (pretax return on assets)	0.08	0.10	0.13	0.12	0.16
X					
After-tax income/Pretax income (profit retention factor)	0.50	0.50	0.60	0.51	0.17
=					
After-tax income/Average total assets (after-tax return on assets)	0.04	0.05	0.08	0.06	0.03
X					
Average total assets/Average total equity (leverage factor)	1.33	1.34	1.34	1.30	1.39
=					
After-tax income/Average total equity (net return on equity)	0.05	0.07	0.10	0.08	0.04
X					
1 - Dividend payout ratio (earnings retention rate)	1.00	1.00	1.00	1.00	1.00
=					
Internal growth of common equity (as a percentage)	5.48	6.65	10.46	7.81	3.89

Table 10
Operating Record
($ in millions, except per share data)

[Part 1 of 2]

Year Ended September 30	Net Sales	Pretax Income	Pretax Margin	Net Income	Tax Rate	Return on Equity
F1985	$624.1	$56.4	9.0%	$34.4	39.0%	8.7%
F1984	532.6	56.3	10.6	33.2	41.0	9.7
F1983	418.3	50.4	12.0	30.8	38.9	11.0
F1982	312.1	46.7	15.0	29.8	36.2	13.1
F1981	208.4	50.2	24.1	26.5	47.2	19.1
F1980	109.0	21.0	19.3	10.7	49.0	20.4
F1979	56.0	10.0	17.9	4.9	51.0	20.6
F1978	24.3	4.4	18.1	3.4	22.7	37.4
F1977	7.7	0.4	5.2	0.3	25.0	11.9
% Increase (Decrease)						
F1985 v. F1984	17%	0%		4%		
F1984 v. F1983	27	12		8		
F1983 v. F1982	34	8		3		
F1982 V. F1981	50	(7)		12		
F1981 v. F1980	91	139		148		
F1980 v. F1979	95	110		118		
F1979 v. F1978	130	127		44		
F1978 v. F1977	216	1000		1033		
Compound Growth						
F1977 - F1980	142%	274%		229%		
F1980 - F1985	42	22		26		
F1975 - F1985	73	86		81		

[Part 2 of 2]

Year Ended September 30	Earnings Per Common Share (a)	Price Range	P/E Range	Mean P/E to S&P 400 Average	Equity
F1985	$0.82	$28 5/8-13 1/8	35-16	2.55	420
F1984	0.80	40 1/4-13	39-13	2.64	375
F1983	0.76	39 1/2-23 5/8	52-31	3.51	311
F1982	0.76	32 3/4-14 1/4	43-19	2.99	251
F1981	0.72	34 5/8-20 3/8	48-28	4.45	205
F1980	0.35	25 3/8-6 1/8	72-17	5.27	73
F1979	0.20	7 1/8-3 3/4	36-19	3.87	32
F1978	0.10	6 1/8-2 1/4	62-19	4.93	15.5
F1977	0.01	2 5/8-1 7/8	NM	NM	2.7

% Increase (Decrease)

F1985 v. F1984	2%
F1984 v. F1983	5
F1983 v. F1982	0
F1982 V. F1981	6
F1981 v. F1980	106
F1980 v. F1979	75
F1979 v. F1978	100
F1978 v. F1977	900

Compound Growth

F1977 - F1980	227%
F1980 - F1985	19
F1975 - F1985	73

(a) Adjusted for stock dividend of 200% in July 1981, and 100% in July 1980.

[Graphical Material Omitted: Figure 1 - Summary Ratings]
[Graphical Material Omitted: Figure 2 - Ease Of Use]
[Graphical Material Omitted: Figure 3 - Software]
[Graphical Material Omitted: Figure 4 - Technical Support]
[Graphical Material Omitted: Figure 5 - Reliability]
[Graphical Material Omitted: Figure 6 - Maintenance Service]
[Graphical Material Omitted: Stock Chart]

N.B.: The First Boston Corporation has, within the last three years, served as a manager or co-manager of a public offering of securities for Citicorp, Concurrent Computer, Hewlett-Packard, IBM, J.C. Penney and Wells Fargo. The First Boston Corporation makes a primary market in issues of Concurrent Computer, Stratus Computer and Tandem Computers.

February 9, 1987

Tandem Computers Inc. - Company Report
FIRST BOSTON CORPORATION (THE) - Peterson, M.S.
12-17-86 (RN=618513)

TANDEM COMPUTERS INC. (TNDM)

Trimming First Quarter Estimate But
Fundamentals Still in Place; Opinion: BUY

Price (*) 12/16/86	Earnings Per Share (a)		P/E Ratios	Div'd Yield	52-Week Price Range
35 1/4	1988E	$2.30	15.3X		--
	1987E	2.00	17.6		--
	1986A	1.44			39 1/2-19 1/2

(*) On 12/16/86 the DJIA closed at 1936.1 and the S&P 400 at 278.0.
(a) Fiscal year ends September 30.

Common Shares -- 46.2 mil.
Market Value -- $1.6 bil.
Book Value/Share -- $10.10
L.T. Debt as % Total Capital -- 4.9%
Return on Avg. Equity -- 8.2%
Est. Future EPS 5 Yr. Growth Rate -- 17%

Conversations with management on December 16 about the December quarter suggest that our previous $0.43 estimate is perhaps a nickel too rich.

* The lower estimate is still consistent with management's guidance going into the quarter. At the September 29 analysts' meeting, management gave guidelines of roughly 23% revenue growth with slightly higher R&D and MG&A and a little heavier tax rate. This will produce a F1987 first quarter below F1986 fourth quarter's $0.47, but ahead of F1986 first quarter's $0.28.

* With two weeks left in the quarter, management says a continuing strong international market and a modest domestic strengthening makes the 23% revenue growth a reasonable number, it could even be a bit light. With higher R&D, MG&A and taxes, the company looks to deliver a quarter closer to $0.38-0.40 and still have a comfortable comparison with last year's $0.28.

This does not change our opinion of Tandem's fundamentals, but we do think it will affect how the stock acts between now and the quarter's release.

The Tandem story is still a strong one.

* Revenue growth is in the low twenties at a time when Prime, Data General and Wang are living with single-digit gains.

* Products are designed especially for the fast-growing transaction processing market, versus DEC's half-baked solution and IBM's expensive mainframe or channel-conflicted private label offerings.

* The company has a network solution that now works across remote locations.

* The company has a diverse and healthy customer list, including financial services, the RBOCs, retailers, manufacturing shop floor controls, airlines and medical OEMs.

Therefore, we are keeping our F1987 estimate at $2.00 with the assumption that it will only take a few bigger contract wins to add some upside surprise to TNDM's second half. At 17.6X F1987 and 15.8X calendar 1987 earnings of roughly $2.20, TNDM's stock still has its skeptics and looks cheap.

However, the Street has been at $0.43 for the quarter and we do not believe that consensus has revised downward. Last quarter's surprise on the upside has been interpreted as a windfall rather than some favorably timed expenses, a more accurate view. Therefore, we expect to see the stock bounce around $33-37 as one analyst cuts his number and another seizes the stock's weakness to pound the table.

The Street range for the year is $1.80-2.10 with the average around $1.85-1.90. Should some analysts overreact to the quarter's guidance or the quarter come in much below $0.37, we could see the stock act weak between now and the end of January. We would use this air turbulence to accumulate TNDM on weakness.

December 16, 1986 closing prices:

Data General (DGN) : 32 1/4
Digital Equipment (DEC) : 106 1/4
IBM (IBM) : 128 1/8
Prime Computer (PRM) : 17 3/4
Wang Labs (WAN.B) : 12 3/4

N.B.: The First Boston Corporation has, within the last three years, served as a manager or co-manager of a public offering of securities for Data General and IBM.

MIS Week 2/16/87 p17

Tandem, Boeing Chart Joint Projects

By SCOTT REEVES

CUPERTINO, Calif.—Tandem Computers Inc. here and Boeing Computer Services Co., Bellevue, Wash., have agreed to explore the integration of their products for the manufacturing and network markets.

Financial terms of the agreement were not announced.

"We are in the exploratory phase," said Ken Linarelli, a public relations manager for Boeing. "We are exploring possibilities for marketing applications. It may lead to developing new products, services or a combination of existing services or products—and it may lead nowhere."

Linarelli said the companies have signed a one-year memorandum of understanding to determine what types of joint manufacturing applications might be explored, as well as a two-year agreement to work with large Tandem users to develop networks.

Manufacturing Automation Protocol (MAP) and Technical Office Protocol (TOP) standards will be discussed, Linarelli said.

Applications to be evaluated for possible joint projects include document handling, shop-floor control and advanced cell-control systems, the companies said in a joint announcement.

Boeing Computer Services Co., a division of Boeing Co., will assist Tandem users in setting up custom networks and large on-line transaction processing applications on Tandem NonStop computers.

Joyce Strand, a spokeswoman for Tandem Computers, said the company does not write application software.

"Tandem has many third parties that provide manufacturing software," Strand said. "We think Boeing is a serious player in the manufacturing marketplace and we therefore felt it would be important to develop a relationship with them."

If the agreement works out as expected, the companies could submit joint bids in the future, she said.

Govt. Contract Expertise

"We're not yet sure how it would work with government contracts," Strand said, "but since Boeing has a great deal of experience in the field, I assume Tandem would bow to Boeing's expertise in marketing to government contractors."

Gerald L. Peterson, Tandem vice president of marketing, said the company is seeking to expand its market share in the manufacturing industry.

He said manufacturers could use on-line information for the control and integration of corporate business planning with plant operations. He said the new relationship between Tandem and Boeing could produce "comprehensive" solutions to achieve such integration.

Boeing will provide project management services, design and development of application software solutions, support and education as well as the integration of its products with those supplied by other companies, according to the agreement.

Alvin M. Savio, vice president of Boeing Computer's commercial services group, said the market for on-line processing for control of the factory floor and networks is growing rapidly.

Tandem manufactures and markets computer systems and networks for on-line transaction processing.

Nixdorf

HONG KONG—
the West German
technology supplier
ed one of the larg
contracts ever in M

Under the terms
million contract, N
laysian subsidiary,
puter (Malaysia) S
install a compre
tributed data proce
for 85 district of
Malaysian Nationa
Board (NEB) durin
years, a Nixdorf
said.

The network will
ly for improving th
NEB's accounting
systems.

The contract cal
to provide each NE
8860 System, config
4 Mbytes of mem
tems will be linked
et-switching lines
Telecom's Maypac
in Kuala Lumpur a
end processors to
mainframe.

In addition a sep
be installed at the
center and anoth
used for in-house

EC Proposes Dumping Halt

BRUSSELS—The European Economic Community (EC) has proposed a new set of anti-dumping rules to crack down on so-called "screwdriver operations" which assemble finished products from imported parts.

The 12-nation EC said the proposed rules were necessary to prevent circumvention of anti-dumping duties. While the measures would apply to any company manufacturing products in EEC they are primarily aimed at Japanese firms assembling products in Europe.

The EC currently applies anti-dumping penalties to electronic typewriters, facsimile machines, photocopiers and other products imported from Japan. An inquiry into the dumping of semiconductor memories is currently underway.

The rules would apply dumping penalties to imported parts used for the assembly of products subject to anti-dumping duties. The rules would come into force only of local assembly plants.

He said the new rules were necessary to stop companies from circumventing anti-dumping penalties. They are in conformance with General Agreement on Trade and Tariffs (GATT) guidelines, he added.

The new measures, if approved by the Council of Ministers, are sure to intensify the growing trade friction between Japan and the EC. It was not clear how the proposals would affect existing Japanese plants: application of anti-dumping penalties to parts would be decided by the council on a case-by-case basis.

—Jonathan Weber

Versatec Initiates Three New Centers

SANTA CLARA, Calif.—Versatec, a Xerox company, has opened three new centers for distributing its electrographic and

Memorex Free T

By LESLIE GOFF

NEW YORK—Memorex Corp. is on its own again and in the midst of a relocation from its former Santa Clara, Calif. headquarters, which ex-parent Unisys Corp. retains, to its new Milpitas, Calif., headquarters a short distance away.

Independence brings with it more than just relocation, however. Independence requires redefinition, and Sergio Mazza, president of what was once the Memorex subsidiary of Unisys and is now the U.S. subsidiary of Memorex International NV, has been on the road visiting customers, redefining the company's role and reassuring them the company is solidly on its feet.

"The Memorex of the past is not the Memorex of today," Mazza said last week, emphasizing that its disk drive manufacturing activities—traditionally the 26-year-old company's weak spot—remain with Unisys.

"Having done that," he added, "you see a company that historically has been very profitable,

manufacturer
tionships to the
rived 50 percent
and 80 percent of
sourced products
Memorex handles
with IBM interfac
compatibility.

"We were a mu
tive distributor
turer," he said.
bought Memorex
isys, not only did
media group bac
we also left behin
manufacturing."

The company
source its disk d
isys under a three
exclusive "agree
requiring a redef
mer parent-su
tionship. Memor
small part of the
a customer.

The agreemen
Memorex to buy
another vendor
offer competiti
formance, relia
meet first custo
new products or

February 9, 1987

Tandem Computers Inc. - Company Report
FIRST BOSTON CORPORATION (THE) - Peterson, M.S.
12-17-86 (RN=618513)

TANDEM COMPUTERS INC. (TNDM)

Trimming First Quarter Estimate But
Fundamentals Still in Place; Opinion: BUY

Price (*) 12/16/86	Earnings Per Share (a)		P/E Ratios	Div'd Yield	52-Week Price Range
35 1/4	1988E	$2.30	15.3X		--
	1987E	2.00	17.6		--
	1986A	1.44			39 1/2-19 1/2

(*) On 12/16/86 the DJIA closed at 1936.1 and the S&P 400 at 278.0.
(a) Fiscal year ends September 30.

Common Shares -- 46.2 mil.
Market Value -- $1.6 bil.
Book Value/Share -- $10.10
L.T. Debt as % Total Capital -- 4.9%
Return on Avg. Equity -- 8.2%
Est. Future EPS 5 Yr. Growth Rate -- 17%

Conversations with management on December 16 about the December quarter suggest that our previous $0.43 estimate is perhaps a nickel too rich.

* The lower estimate is still consistent with management's guidance going into the quarter. At the September 29 analysts' meeting, management gave guidelines of roughly 23% revenue growth with slightly higher R&D and MG&A and a little heavier tax rate. This will produce a F1987 first quarter below F1986 fourth quarter's $0.47, but ahead of F1986 first quarter's $0.28.

* With two weeks left in the quarter, management says a continuing strong international market and a modest domestic strengthening makes the 23% revenue growth a reasonable number, it could even be a bit light. With higher R&D, MG&A and taxes, the company looks to deliver a quarter closer to $0.38-0.40 and still have a comfortable comparison with last year's $0.28.

This does not change our opinion of Tandem's fundamentals, but we do think it will affect how the stock acts between now and the quarter's release.

The Tandem story is still a strong one.

* Revenue growth is in the low twenties at a time when Prime, Data General and Wang are living with single-digit gains.

* Products are designed especially for the fast-growing transaction processing market, versus DEC's half-baked solution and IBM's expensive mainframe or channel-conflicted private label offerings.

* The company has a network solution that now works across remote locations.

* The company has a diverse and healthy customer list, including financial services, the RBOCs, retailers, manufacturing shop floor controls, airlines and medical OEMs.

Therefore, we are keeping our F1987 estimate at $2.00 with the assumption that it will only take a few bigger contract wins to add some upside surprise to TNDM's second half. At 17.6X F1987 and 15.8X calendar 1987 earnings of roughly $2.20, TNDM's stock still has its skeptics and looks cheap.

However, the Street has been at $0.43 for the quarter and we do not believe that consensus has revised downward. Last quarter's surprise on the upside has been interpreted as a windfall rather than some favorably timed expenses, a more accurate view. Therefore, we expect to see the stock bounce around $33-37 as one analyst cuts his number and another seizes the stock's weakness to pound the table.

The Street range for the year is $1.80-2.10 with the average around $1.85-1.90. Should some analysts overreact to the quarter's guidance or the quarter come in much below $0.37, we could see the stock act weak between now and the end of January. We would use this air turbulence to accumulate TNDM on weakness.

December 16, 1986 closing prices:

Data General (DGN) : 32 1/4
Digital Equipment (DEC) : 106 1/4
IBM (IBM) : 128 1/8
Prime Computer (PRM) : 17 3/4
Wang Labs (WAN.B) : 12 3/4

N.B.: The First Boston Corporation has, within the last three years, served as a manager or co-manager of a public offering of securities for Data General and IBM.

APPLICATION REPORT

SMALL SYSTEMS

ON-LINE TRANSACTION PROCESSING UPDATE

EXECUTIVE SUMMARY

The use of computer technology to lower costs, improve productivity, and deliver services directly to customers is the driving force behind the on-line transaction processing (OLTP) market. InfoCorp expects the annual worldwide market for OLTP systems to expand from $24.6 billion in 1986 to $52.9 billion by 1991.

OLTP applications allow on-line disk files to be accessed and updated by a community of interactive users. The on-line data files serve as a real-time information model of the enterprise. As external events change the state of the business, OLTP applications capture information about the events (in the form of transactions) and change on-line data files to reflect the new state. Transactions are processed as the event occurs, keeping the information model synchronized with the business. Such applications are real-time management tools that provide up-to-the-minute information about the business users of the system. InfoCorp defines OLTP applications as those that provide shared on-line access to disk-based data, subject to on-line update. This definition includes a wide variety of applications on multiuser systems of all sizes.

OLTP is the fastest growing sector of the commercial computing market. The worldwide OLTP market grew at a compound annual growth rate (CAGR) of 30.1 percent from 1981 to 1986. The market segment for systems costing less than $50,000 grew at 49.9 percent over the same period. Worldwide market growth will slow to 16.6 percent by 1991, with the growth rate of small-scale systems moderating to 35.2 percent. The medium-scale and large-scale OLTP market segments will approximately double in size, with five-year growth rates of 16.4 percent and 13.6 percent, respectively.

Although all OLTP segments are driven by the buyers' desire to increase efficiency and productivity, each segment operates under different buyer selection criteria. The small-scale systems segment is driven by cost-of-solution and is heavily influenced by industry standards. The medium-scale systems segment is backlog-bound, focused on time-to-solution. The large-scale systems segment is dominated by mission-critical applications and their requirement for massive throughput and absolute application/data base integrity. Each segment has different market and technical requirements; each requires a distinct strategy.

IBM is the dominant OLTP vendor, with more than three times the market share of its closest competitor in each segment. However, IBM's future dominance is not necessarily assured. Between 1981 and 1986, IBM lost share in

the small-scale and large-scale systems market segments. IBM and Digital Equipment are currently battling for the medium-scale systems segment, with system prices under extreme pressure.

The OLTP market is fragmented. As segment requirements diverge, InfoCorp believes a window of opportunity is opening for OLTP suppliers. It is unlikely that any vendor, including IBM, can fully address the needs of all segments. Shifts in market share between 1981 and 1986 suggest that suppliers that focus on specific segments can gain share against entrenched competition. Vendors with segment-specitic strategies can benefit from tailored technology and build a sustainable competitive advantage. InfoCorp believes that organizations that successfully match their technology and business strengths to the needs of appropriate OLTP market segments will prosper through the 1990s.

INTRODUCTION

The on-line transaction processing (OLTP) market came into existence in the mid-1960s, the enabling technologies being random-access disks and interactive terminals. Before the invention of these devices, transaction data was recorded on punched cards. Information about the state of the business was stored on magnetic tape. Periodically, groups of transaction cards were processed with the magnetic tape, producing a new magnetic tape and stacks of paper reports. The reports were current through the most recently processed keypunched transaction. A few critical transactions were processed daily, but most ran on weekly or monthly schedules. Thus, users of the printed reports had current information only a few times a month at best.

Batch processing was necessary because magnetic tape required sequential processing. The following hypothetical order-processing application illustrates the concept. A company with 15,000 customers had a magnetic tape record for each customer, with the customer file stored on one or more reels of tape. As purchase orders arrived in the mail, each order transaction was recorded on a punched card. Periodically, batches of new-order transactions were processed against the customer file, creating an updated customer file. The computer program retrieved each customer record from the magnetic tape, checking to see if there was an order transaction. If an order card existed, the new order information was added to the customer record, and the changed customer record written to a new customer file. If there was no order card, the computer copied the unchanged customer record to the tape. This procedure was repeated until each customer record had been processed. It was necessary to manipulate data about all 15,000 customers, even though only 100 placed orders. Because a magnetic tape cannot be randomly positioned to a specific customer, application programs spent enormous amounts of time simply copying unchanged data.

Magnetic disk devices allow single records to be directly accessed, and changed without affecting other records in a file. Terminals allow people who create transactions, such as reservation clerks at airline counters, to send transaction data directly to an on-line computer. Terminals eliminate the need to record the transaction on a punched card. Terminals and disks on the same system allow transactions to be recorded and processed as they occur. They also allow information to be displayed on a terminal, instead of being

printed. Thus, the delays associated with batch processing can be eliminated by doing all the processing immediately, when the transaction occurs.

The first OLTP application systems were jointly developed by air carriers and computer vendors to process airline reservations. In a sense, OLTP made modern air travel feasible. Without on-line access to seat information, airline companies could not manage flight bookings very well. Without a minute-by-minute picture of seat availability, airlines were losing revenue from last-minute passengers because they could not assure these passengers of an available seat. On-line reservation systems allowed airlines to sell seats up until flight departure. They also allowed clerks to provide guaranteed reservations to passengers. Since unsold seat inventory expired when an airplane took off, the ability to process reservations in real time was invaluable. It was also extremely expensive: Over a ten-year period, American Airlines invested more than $350 million in its Sabre reservation system.

Although up-to-the-minute information is valuable in many situations, only the most highly leveraged applications were worth the cost of early OLTP. Over time, computer economics changed. Computer hardware costs decreased at a compound rate of 20 to 30 percent per year, making OLTP viable for more applications. Not all on-line applications are engaged in OLTP; some capture information for later processing. True OLTP applications process transactions to completion as they occur, typically while a human being waits for the results of the processing. The need to respond to the user within a reasonable time period makes OLTP significantly more complex and demanding than applications that merely record transactions for later processing.

The benefits provided by OLTP applications stem from their ability to provide up-to-the-minute information about the business. Faster information flow allows an organization to be more efficient and productive. Today's OLTP market is the fastest growing portion of the commercial computing market. The 1986 worldwide OLTP market was $24.6 billion and grew at a 30.1 percent CAGR between 1981 and 1986. This compares with a growth rate of 18.5 percent per year in the total worldwide information processing market.

Much of this growth is the result of computers moving out of the accounting office and into the business revenue stream. OLTP technology is a key competitive weapon in a wide range of industries including:

- Financial Services--Applications like stock brokerage, cash management, and automatic teller machine (ATM) support are integral to revenue production. The computer acts as a delivery vehicle to provide services to the customer.

- Retailing--Credit authorization, inventory control, and point-of-sale applications have a major impact on operations and customer service.

- Manufacturing--Factory automation, just-in-time inventory systems, and "paperless factories" all improve employee productivity and asset management.

- Telecommunications--As the impact of the Bell system breakup continues to spread, value-added services such as directory assistance, credit card authorization, and access to on-line data bases are becoming a key revenue source for telephone companies.

Each of these applications is at the very heart of the business; all directly impact the bottom line. Applications of this type are relevant to businesses of all sizes, in all industries. In OLTP applications, the computer is an active component of the business, not an after-the-fact scorekeeper.

The OLTP market is divided into three segments, each segment based on the price of the OLTP computer hardware and systems software that serves it. Although each segment exhibits distinct buyer behavior patterns, all share common requirements. After defining these requirements, this Application Update Report reviews the market segments, historical/forecast trends, and market share information. The report then examines key issues in each market segment and suggests technology strategies for vendors that wish to serve these markets.

OLTP vendors must meet five basic requirements for success in on-line transaction processing:

- Performance--OLTP applications are the most demanding of all commercial computer applications. The transaction must be processed to completion while a human being waits for the results. Many transactions occur at the same time, contending for the same computer resources and information.

- Data Integrity--The most important market requirement is protection of the on-line data base. Although a broken computer may temporarily cripple or even halt the business, an incomplete or incorrect data base creates chaos throughout the entire enterprise. The most valuable element of the system is the information on the disks supporting the on-line environment. The most crucial requirements of any on-line system are establishing and preserving the correctness of the data base.

- Expandability--All successful on-line applications have one common characteristic--they grow. If a crucial function is provided on-line, the business cannot grow unless the system can expand. Thus the ability to support increases in OLTP workload is a fundamental market requirement.

- High Availability--As OLTP applications proliferate, the direct and indirect costs of computer failure skyrocket. As the enterprise increasingly relies upon the computer, keeping crucial applications available on a continuous basis becomes more important. This requirement is particularly stringent when the computer is part of the revenue stream.

- Ease of Application Development--A major obstacle to the widespread use of OLTP is the cost and complexity associated with programming and maintaining applications. OLTP applications cannot impact the bottom line while they are backlogged. The market demands systems that are easy to program.

OLTP MARKETS

Tables 1 through 4 illustrate historical growth in the worldwide and U.S. OLTP market from 1981 through 1986, as well as forecasted growth through 1991. Market growth was triggered by increased demand for OLTP applications, supported by improvements in underlying hardware technology in the form of faster, cheaper computers.

The market is divided into three distinct segments, based on the average selling price (ASP) of OLTP systems:

- The small-scale OLTP system segment includes systems with an ASP of less than $50,000. It grew at a five-year compound rate of 49.9 percent, to $1.6 billion in 1986.

- Medium-scale OLTP system ASPs range from $50,000 to $350,000. Between 1981 and 1986, the medium-scale system segment grew at 27.5 percent CAGR, to $8.3 billion.

- Large-scale OLTP systems accounted for virtually all growth in the mainframe sector, as a 30.2 percent CAGR took this market segment to $14.6 billion.

During the 1981 to 1986 analysis period, improved hardware price/performance and increased demand for on-line facilities contributed to a 30.1 percent CAGR and a $24.5 billion worldwide market. Growth rates will moderate in this market by 1991, yielding a $52.9 billion worldwide market and a 16.6 percent CAGR. The small-scale system segment's 35.7 percent CAGR will outpace the others during the forecast period, to a $7.4 billion 1991 market. During the same period, the medium-scale system segment will expand at a 16.4 percent CAGR, to $17.8 billion, while a 13.6 percent growth rate will nearly double the large-scale system segment, to $27.7 billion.

Tables 3 and 4 summarize history and forecasts for the U.S. portion of the market. In general, between 1981 and 1986, U.S. market segments grew 2 to 5 percent faster than comparable worldwide segments between 1981 and 1986. Over the forecast period, InfoCorp expects worldwide segments to grow 2 to 3 percent faster than U.S. segments. By 1991, the U. S. OLTP market will grow to $25.2 billion, on a 15.8 percent CAGR.

Small-Scale OLTP Systems

The small-scale OLTP systems segment consists of multiuser systems with an ASP of less than $50,000. Historically, this segment has been dominated by

vendors with large direct salesforces, such as Digital Equipment, Hewlett-Packard, and IBM. The past four years have seen the emergence of new market players that captured 14 percent of the segment. Their emergence was enabled by the convergence of two technology advances:

- Very Large Scale Integration (VLSI)

  During the mid-1970s, medium-scale integration (MSI) enabled the commercial minicomputer market to come into existence. System suppliers used MSI technology to build low-cost minicomputers.

  Eventually, commercial systems software (e.g., COBOL language compilers, data base management system (DBMS) software, job control languages (JCL), etc.) was added to the MSI minicomputer hardware foundation, creating low-cost business systems. The combination of MSI hardware and business support software lowered the system-level OLTP price floor from $500,000 to $150,000.

  In an analogous fashion, very large scale integration (VLSI) shattered a comparable barrier in today's small-scale system market. Off-the-shelf VLSI microprocessor hardware reduces the system-level OLTP price floor from $50,000 to $10,000. The availability of VLSI hardware was necessary, but not sufficient, to enable the market. A comparable software advance was also required.

- Standard Operating Systems Software

  With VLSI hardware cost so low, it was necessary to rethink the systems software equation. In the mid-1970s, minicomputer vendors invested in the development of commercial languages and utilities to enter the small business systems market. The multimillion dollar systems software development investment was justified by the ability to enter expanded markets. Commercial minicomputer vendors simply added $10,000 to $20,000 in software charges to each commercial system to recover systems software development costs.

  This strategy does not work on commodity microprocessor-based systems, however. No one will pay $20,000 for the operating software to run a $10,000 computer. However, this problem is solved by using standard operating systems like UNIX or Pick. Standard operating systems are hardware-independent. They can be tailored to operate on virtually any new computer, with a small, one-time programming investment.

  Modifying a standard operating system to run on a new computer is referred to as "porting" the software. A typical port requires less than twelve person-months of systems programming effort. It is a one-time project undertaken by the vendor offering the new system. The standard operating system is

then licensed to the buyer for a few hundred dollars per system. Once the port is complete, all systems and application programs written to run under the standard operating system will run on the new computer.

VLSI technology and standard operating systems have dropped the OLTP system price floor to $10,000, opening the market to new suppliers. As new systems based on powerful microprocessors such as the Fairchild Clipper, Intel 80386, Motorola MC68020, National 32032, and Western Electric 32000 flow into the small-scale systems market, ASPs in this segment will trend toward the $10,000 level. Low entry price and improved price/performance will fuel expansion, with the worldwide market expected to grow at 35.2 percent CAGR, to $7.4 billion in 1991. The key to market expansion is the availability of low-cost application software built upon standard operating systems.

Medium-Scale Systems

The medium-scale OLTP systems segment is made up of multiuser systems with ASPs in the range of $50,000 to $350,000. Between 1981 and 1986, the largest number of systems were installed in this segment. Worldwide unit shipments in the small-scale system segment are expected to exceed medium-scale shipments in 1987, however. U.S. small-scale systems unit shipments exceeded medium-scale shipments for the first time in 1986.

The medium-scale segment is expected to outpace the large-scale segment throughout the forecast period. Its growth is fueled by several factors:

- This segment includes the descendants of the commercial minicomputer boom of the mid-1970s and early 1980s. Virtually all suppliers in this segment have overhauled their product lines over the past two years. These larger-capacity systems will replace older installed systems as application volumes increase and new applications are added.

- Increased use of on-line technology in dedicated-system applications, such as just-in-time inventory, paperless factories, cash management, and trading systems. Medium-scale systems are more cost-effective for dedicated applications than multiple-application large-scale systems.

- New applications with unknown market appeal will be prototyped on medium-scale systems. New applications will not move into the glass house mainframe environment until their operational characteristics and implications are well understood.

- Increases in departmental and distributed computing will result in significant growth in networked medium-scale OLTP systems. Such systems will provide access to their data bases to upstream mainframes, peer medium-scale systems, and downstream users of small-scale systems and dedicated PCs.

The key issues in this segment are time-to-solution (the amount of time required to build new applications) and networking. Relational data base

technology and fourth-generation languages will speed new application development. Standard operating system technology will also open this segment to machine-independent applications. Interconnection of systems will be facilitated by use of standard communication interfaces, aided by the emergence of heterogeneous networking. Toward the end of the forecast period, expert systems will impact computer-aided software engineering and network management.

Large-Scale Systems

The large-scale OLTP systems segment includes systems with average selling prices (ASPs) exceeding $350,000. Between 1981 and 1986, this segment accounted for 57.2 percent of OLTP system value and only 7 percent of unit volume. Although this segment will have the slowest growth over the forecast period (13.6 percent CAGR), it will still account for more than 52 percent of system value in 1991.

Growth in this segment comes from high-volume applications. Increases in volume can be seen in many industries. Industry-specific examples include:

- Financial Services--Today's electronic (e.g., computer-based) payment systems utilizing automatic teller machines (ATMs) and point-of-sale devices automate less than 3 percent of payments. Bank debit card and shared ATM applications are expected to double transaction volumes by 1990.

- Retailing--Retailers in the department store, service station, and convenience store sectors are all considering large-scale point-of-sale (POS) applications, with several dozen in prototype.

- Telecommunications--Value-added services such as credit card authorization, line equipment data bases, directory assistance, and 800-number support are all high-volume applications. Increasingly, the telephone operating companies will replace use of fee-based AT&T services with new dedicated systems.

Typical high-end application transaction volumes are expected to increase fourfold, from 30 transactions per second (tps) to 125 tps by 1990.

The key issues in this segment are transaction throughput, protection of the integrity of applications and data, application development time, and system availability. At a philosophical level, growth in this segment flows from the use of on-line technology to make business more competitive. This segment supports mission-critical and strategic information systems.

MARKET SHARES

IBM is the dominant OLTP vendor, with more than three times the market share of its closest competitor in each segment. Despite its position, IBM's future dominance is not necessarily assured. Between 1981 and 1986, IBM lost share in the small-scale and large-scale market segments. IBM and Digital

Equipment are currently battling for the medium-scale market, with system prices under extreme pressure. Since requirements vary so widely across market segments, it is most useful to discuss competitive factors within each segment.

Small-Scale Systems

IBM has dominated the worldwide small-scale OLTP systems market throughout the analysis period, with 47.7 percent market share (see Tables 5 and 6). Digital Equipment is the most significant second player, with 13.2 percent of the market. IBM market share decreased by 5.2 percent from 1981 to 1986, while Digital's share increased by 3.0 percent. During the same time period, Hewlett-Packard dropped from 2.3 percent in 1981 to 0.8 percent in 1984. Modernization of the product line allowed H-P to recover nicely, expanding its market share to 3.3 percent in 1986.

Closer review of market share shifts highlight the impact of standard operating system software in this segment. During the analysis period, AT&T gained 3.6 percent market share, Altos 2.7 percent, and NCR 1.2 percent. Because of the relative low-cost of their systems, these three vendors gained 9.7 percent unit share. Table 7 summarizes the impact of UNIX and Pick on worldwide unit shipments. UNIX unit share increased from 1.1 percent in 1981 to 16.7 percent in 1986, while Pick's unit share increased from 0.1 percent to 2.3 percent.

As more powerful hardware enters this market, InfoCorp expects to see continued unit share expansion in the commodity technology products. It is also possible that the trend away from IBM systems will continue. All of IBM's share is held by proprietary products. But UNIX environmental software that allows System/36 programs to run under UNIX has recently appeared in the market.

An interesting market shift has been executed by NCR. At the start of the analysis period, NCR had no market share. Its shift to UNIX with the Tower product is responsible for its performance.

Medium-Scale Systems

IBM is the major supplier in the medium-scale OLTP market, with a 39.7 percent market share (see Tables 8 and 9). Digital Equipment and Tandem each hold 8.2 percent of the market, followed by Nixdorf with 4.7 percent.

The impact of standard operating system software is surprisingly strong in the market. As illustrated in Table 10, UNIX accounted for 4.7 percent of unit shipments in 1986, up dramatically from 0 percent in 1981. The biggest winner is Arete, with 4.6 percent of medium-scale units and a third of the UNIX units. Pick's unit shipments declined from 4.2 percent in 1981 to 1.5 percent in 1986, possibly as a result of Pick environmental support under UNIX. The impact of standard operating systems will increase in the future, as more powerful systems become available and application availability improves.

The more important factor in holding market share in this segment is the time required to build new applications. Tandem has historically had an advantage in this arena, provided by its Pathway and Encompass products for

OLTP applications support. For Digital Equipment and IBM users, third-party tools such as relational data base management systems and fourth-generation languages have met the need for rapid application development. Comparable tools are now also available for UNIX systems. In 1986, 62.9 percent of the market was served by vendors with access to high-quality application development tools.

The battle between IBM and Digital is most clearly seen when both market share and volume data are reviewed. Table 11 highlights IBM and Digital market share data, in both value and units, from 1981 through 1986. IBM held 38.2 percent of the market value in 1981, on 28.7 percent of units. As Digital's market share increased, IBM lost and then regained value share while continuously increasing unit share. IBM ended the analysis period with a 1.5 percent increase in market value and a 10.1 percent increase in unit share. InfoCorp believes this shift signifies price erosion of IBM systems in response to pressure from Digital. Future changes in market share will, in large part, hinge on the success of IBM's 9370 medium-scale systems offensive.

Large-Scale Systems

As illustrated in Tables 12 and 13, IBM dominates the large-scale OLTP segment, with a 58.5 percent share of market value. The segment is mainframe-oriented, with BUNCH survivors and producers of plug-compatible systems accounting for 30.1 percent market share. Digital Equipment, Data General, Prime, and Tandem share 8.9 percent of the market, with upscale superminicomputers. This segment is best analyzed in two subsegments: low-end systems with ASPs of $350,000 to $1,749,999 and high-end systems with ASPs $1,750,000 and higher.

Buyers of systems in the $350,000 to $1,749,000 range are, like the medium-scale buyer, focused on ease of application development. All the same factors discussed in medium-scale systems apply here.

The ultra-high-end systems with ASPs above $1,750,000 have very special requirements. This is the portion of the market that supports high-volume, "bet the business" applications. Table 14 shows IBM dominant, with 64.7 percent of the market. Plug-compatible mainframes (PCM) from Amdahl, Fujitsu, Hitachi, and NEC serve 15.2 percent. Unisys holds the number two spot, with 15.1 percent share. Tandem is a new player in this arena, with its VLX system. Announced in April 1986, with first shipments in June, this system garnered 1.9 percent of the market in seven months.

Historically, the ultra-high-end portion of the market is capacity-limited by the power of top-of-the-line systems. The PCMs have traded market share with IBM over the years, depending upon their various positions within their respective product life cycles. Applications that run on these systems often battle with problems caused by limitations in system software. This is the segment of the installed base that drives the demand for ever more powerful systems.

InfoCorp believes this subsegment will be most disrupted by increases in OLTP demand. Processor power historically grows at about 18 percent per year on high-end systems. Historically, most OLTP applications reside on a single

large-scale system. However, in the past two years, transaction rates have outpaced processor growth. In high-end applications, transaction rates are increasing at between 20 and 30 percent CAGR. These growth rates are specifically associated with new, high-volume applications. Over the next five years, transaction volumes will outrun the capacity of high-end mainframes. To meet this demand, IBM must materially improve the capacity of its largest systems. If it fails to meet the challenge, other suppliers will have a clear shot at some of these systems.

Tandem stands to be a big winner in this battle. As transaction volume outruns the capacity of a single system, there are only three solutions:

- Build a bigger system by building a bigger CPU. Once transaction volume overruns the high end of a system, system throughput can only increase at the same rate as underlying processor performance. For the past ten years, processor power has increased at about 18 percent per year. This is not good enough for systems with transaction volumes growing at 40 percent per year.

- Build a bigger system by adding more CPUs, tightly coupled to a shared memory, operating under a single copy of the CPU operating system. IBM's high-end systems have used this approach for more than ten years. The largest 370 system had two CPUs, which could operate as a single system. The largest 3080 system supported four processors, and a recently-announced 3090 will employ six CPUs. From the customer's view, these multiprocessor systems look like a single large system. IBM's largest customers have already saturated the largest four CPU systems.

  System growth through the addition of tightly coupled CPUs has proven to be viable with only small numbers (less than eight) of CPUs. As CPUs are added to a tightly coupled system, each CPU contributes less than 100 percent of its unit processing power to the system. For example, a four-CPU 3090 Model 400 is less than twice as powerful as a two-CPU 3090 Model 200. This falloff in effective CPU power is due to resource contention in the single operating system shared by all CPUs. Some operating system functions can run on only one CPU at a time. If two or more CPUs require access to such a function, one CPU waits until the other is through. At some point, adding another CPU to a tightly coupled system adds no processor power because contention effectively keeps the additional CPU idle. For the past ten years, multiprocessor system capacity has also increased at 18 percent per year. The shift from four to six CPUs in the 3090 will add less than 50 percent additional capacity.

- Build a bigger system by adding more CPUs, closely coupled to a high-speed system bus, operating under multiple operating systems. This is the Tandem approach. Closely coupled systems are characterized by the ability to perform remote

operations (those in another CPU) with no more than 10 percent degradation in the performance of the operation. For example, reading a record from a remote disk adds no more than 10 percent to the time required to read a record from a local disk.

Because each CPU in a closely coupled system operates under its own operating system, additional CPUs contribute their full processing power to the system. Thus, a four-CPU system is twice as powerful as a two-CPU system, while a sixteen-CPU system is eight times as powerful as a two-CPU system. Tandem tests demonstrate linear growth through more than thirty CPUs. The 90 percent efficiency characteristic on remote activities allows large collections of CPUs to function as a single, large system. Because the power of a single CPU is multiplied in a closely coupled system, increases in CPU power also multiply. Between 1982 and 1986, Tandem increased the power of its systems at 40 percent per year.

Tandem's VLX system has a minumum of four CPUs, expandable in four CPU increments to sixteen processors. The early success of this system is based on its ability to outperform high-end IBM systems, in full-function (e.g., CICS, IMS, or IMS Fastpath) software environments. Tandem's customers verify a minimum 2-to-1 cost advantage over IBM systems with comparable transaction processing power. If NCR's 9800 Series systems demonstrate linear growth in large environments and meet the 90 percent efficiency specification, NCR may represent a major competitive threat to Tandem.

IBM is rumored to be working on a closely coupled architecture as part of the next-generation Summit system. To employ close-coupling, IBM must modify its subsystem software to operate in multiple address spaces. In light of IBM's slow evolution to multiple address spaces on existing products, it is unlikely that a viable closely coupled system will appear before the early 1990s.

Digital Equipment is also interested in close-coupling, though it is further away than IBM. VAXCluster systems, including Digital's new VAX 8974 and 8978, employ multiple systems in a loosely coupled network. Each system functions as an independent node in a hidden network. To evolve into a closely coupled system, VAXCluster must first be modified to function as a single system rather than as a collection of independent systems. This requires implementation of functions such as distributed transaction control and recovery, which are not yet available. Once a single-system image is supported, low-speed remote cluster functions, such as remote I/O, must be improved to meet the 90 percent efficiency requirement.

As large-scale applications outrun the transaction capacity of high-end mainframes, Tandem's ability to provide high-volume capacity in full-function software environments should translate directly into improved market share. The gating item on Tandem's growth will be competition from new closely coupled systems and IBM's ability to improve high-end system throughput.

KEY ISSUES

The fragmented OLTP market is best served by segment-oriented vendor product strategies built around a series of key issues. Although discussed elsewhere in the body of this report, key issues for each segment are recapped in this section of the report.

Small-Scale Systems

The small business computing market has always been extremely price-sensitive. The emergence of systems built upon standard VLSI technology has significantly reduced the entry price for OLTP. Market growth will come from two types of organizations, with different needs:

- Small Businesses--This portion of the market is going on-line for the first time. Many buyers have experimented with PCs and are attracted to multiuser on-line systems by low cost. For these buyers, application software availability and support are critical issues. The VAR community is well-positioned to meet the needs of this group.

- Branch Offices--Typified by small work groups located at branch offices of banks, insurance companies, distributors, and retailers, these organizations deal directly with customers, at the point where business transactions occur. Historically, the cost of capturing transactions as they occur has exceeded the value of doing so. The availability of low-cost systems is changing the economics. These buyers are interested in improving branch office productivity and information flow through their organization. Networking is a key issue for this group, as transactions captured here drive the rest of the organization.

Participants in this market should strive to keep cost of solution low through extensive use of commodity technology. Vendors will find it difficult to add value to their systems based on proprietary system components, unless they are also the high-volume supplier. For example, Digital Equipment and IBM have enough market presence to create de facto standards, through brute force. They can (and did) implement their proprietary architectures in VLSI, instead of basing their systems on off-the-shelf components.

Widespread use of commodity components will increase the rate at which products turn in the marketplace. Product cycles will be extremely short, without much time for new product development. In particular, it is necessary to shield software from changes in underlying hardware. Technology strategies should focus on selecting the best combination of standard technologies for a particular target market. Strict adherence to industry standards should allow vendors to innovate at the same rate as the best supplier of that technology.

As commodity products push down margins, suppliers should focus on adding value in areas that impact total cost of solution. Nondevice elements of the product mix--such as distribution, product support, applications, training,

industry knowledge, integration and field service--can become important market differentiators. This requires in-depth knowledge of the target market.

NCR's Tower product strategy is an excellent example of adding value through nondevice elements of the product mix. Tower is a commodity-based product that uses MC68000 processors, Multibus, SCSI disk, and UNIX. NCR adds value through distibution, application software, and support. NCR uses a multiple-channel distribution strategy including direct sales (Fortune 1200 and traditional markets such as retailing, finance, manufacturing, and hospitals), VAR sales (small VARs and nontraditional markets), and OEM sales through Sperry. NCR's catalog of over 145 applications allows it to sell solutions, rather than boxes. Tower established NCR in the small-scale OLTP market by capturing 1.7 percent of the unit shipments in this segment since 1983.

Medium-Scale Systems

The medium-scale systems market is sensitive to functionality, as well as cost. Growth in this segment is driven by two major application classes:

- New Applications--As business becomes more information intensive, OLTP systems are used to increase productivity and generate revenue. New OLTP applications generally fall into two categories--commodity applications and strategic applications.

- Commodity applications are generic and applicable to most companies in a vertical market. They improve productivity and/or reduce cost, but do not typically give the organization long-term competitive advantage. Automatic Teller Machine (ATM) and wire-transfer applications in the financial services market are examples of commodity applications, as are general-purpose on-line accounting systems. Sooner or later, everyone in the vertical market will install such systems, so they offer no competitive advantage. Although these applications are beneficial, they are not valuable enough to justify use of scarce, in-house programming resources. Commodity applications are purchased from independent software vendors (ISVs) or installed on a turnkey basis by value-added resellers (VARs) or system vendors.

- Strategic applications are an outgrowth of the organization's business strategy. When properly conceived and implemented, they embody key elements of business strategy and provide long-term competitive advantage. Channel systems such as on-line order entry and just-in-time inventory that tie customers to suppliers are examples of strategic systems. These systems are built by the in-house programming staff, and the details of the design are protected as trade secrets. Time-to-market is a key issue, translating directly into a market need for high-quality application development tools.

- Integration Applications--The proliferation of computers at all levels of the organization has led to a desire to

integrate the information systems infrastructure. This is especially true of OLTP systems, which capture and process transactions that drive the business. The need to share data throughout the organization on a timely basis is fueling growth in integration applications. PC users increasingly require access to data on other PCs and to mainframe-based data. The proliferation of departmental systems for OLTP and office automation increases the need to communicate horizontally between departmental systems. Finally, OLTP systems must communicate with corporate mainframes and the large-scale batch complex. Ease of integration is a key issue for these applications.

Each application class raises different key issues. Commodity applications are best served by standards-intensive strategies that promote availability of the application on many systems. Standards impact the proprietary sector as well as the commodity sector, particularly in data communications and data base management systems. SQL and SNA LU6.2/PU2.1 are key future standards for all vendors.

Strategic applications are best served by reducing the time required to develop new applications. Historically, the BUNCH survivors have built high-quality development tools for use with their systems. Concurrent is an example of a new market entrant executing a similar product strategy. Concurrent has added comprehensive OLTP application tools to its Reliance family systems and has gained 0.5 percent of the medium-scale market over the past year.

In the future, standards will play a more important role. Over the past few years, the "C" programming language has become a de facto standard for third-party systems software development. DBMS and fourth-generation language (4GL) software written in "C" is portable across a wide range of UNIX and proprietary systems. Each new generation of these hardware-independent systems delivers significant improvements in system functionality and speed. InfoCorp believes that all but the most focused hardware vendors will be hard pressed to match the software evolution speed of the ISVs.

Vendors in this segment should strive to reduce their customer's time-to-solution. In some cases, this can be accomplished by using preprogrammed applications. Emerging standards such as SNA LU6.2/PU2.1 and SQL are important boundaries within which individual vendors can innovate. For example, a proprietary fourth-generation language that produces SQL code is more acceptable than an entirely new language. The most pragamatic course of action is to avoid developing proprietary tools to speed application development unless they use industry-standard interfaces. It is also useful to track third-party advances in distributed data base, heterogenous networking, and computer-aided systems engineering. Any or all of these technologies may well advance the state of the art. Some software vendors also look to AI technology as a foundation for the development of tailored application systems.

Integration and networking seems to be the area where suppliers have the best chance to innovate. Digital Equipment's success in the medium-scale systems arena is due, in part, to easy networking among Digital Equipment and

IBM products. The evolution of SNA will make it easier for IBM products to communicate. It will also make it easier for non-IBM systems to participate in IBM networks. It may well be possible to devise product strategies that conform to IBM network standards while adding significant integration value.

Large-Scale Systems

The issues described for the medium-scale market also impact this segment, where system ASP is less than $1,750,000. Buyers of systems above this price threshold are vitally concerned about protecting the application and high-end transaction throughput. Owing to the enormous reliance of the business on large-scale OLTP applications, fault tolerance and data base restart/recovery are also important product features.

The most important issue is the explosive increase in transaction volume in high-end applications. The most rapid growth is coming from new, strategic applications in market segments that are under intense foreign and domestic competitive pressure. Historically, buyers in this segment have been forced to trade ease of application development and data integrity for high volume. For example, a large-scale IBM system under TPF (Transaction Processing Facility) will run 500 transactions per second (tps) or 50 tps under IMS. The IMS programmer has iron-clad protection of the data base and programs in COBOL, whereas the TPF programmer writes assembler language applications without a data base.

Closely coupled architectures deliver both high volume and robust software. For systems with average selling prices in excess of $1,750,000, closely coupled architectures will become a key survival element. Tandem is already there; IBM and Digital Equipment are on the way. The rest of the market must respond or risk losing the high end.

CONCLUSIONS

The on-line transaction processing market is the fastest growing portion of the commercial computer market. As we move into the Information Age, OLTP systems will provide competitive advantage, as businesses use computers to leverage and support underlying business strategies. This market has always stretched computer technology to its limits and will continue to do so. This Application Update Report has discussed the forces that drive the OLTP market and its size, market share, and key issues. The market is varied and capable of supporting a variety of business and technology strategies. By 1991, the worldwide market will support nearly $52 billion in system sales.

InfoCorp believes that today's major players will continue to dominate the market, though segment boundaries will blur. Commodity technology solutions will gain significant market share in the small-scale systems segment, with room for new suppliers. Proprietary vendors will factor standard technology into their proprietary strategies. Artful integration of high-value proprietary features and industry standards could be a winning combination. The overriding challenge for suppliers is to provide enough functionality to quickly produce new OLTP applications, and enough transaction power to keep ahead of the demand curve.

Sandra J. Gant

TABLE 1
WORLDWIDE ON-LINE TRANSACTION PROCESSING MARKET
TOTAL VALUE
(MILLIONS OF DOLLARS)

ASP	1981	1982	1983	1984	1985	1986	CAGR '81-86
<$50,000	$217	$332	$462	$797	$1,350	$1,638	49.9%
$50,000-$349,999	2,472	3,484	4,749	6,339	7,704	8,341	27.5%
$350,000+	3,902	5,047	6,995	8,909	11,259	14,609	30.2%
Total	$6,591	$8,863	$12,207	$16,045	$20,313	$24,588	30.1%

	1986	1987	1988	1989	1990	1991	CAGR '86-91
<$50,000	$1,638	$2,562	$3,578	$4,809	$6,124	$7,404	35.2%
$50,000-$349,999	8,341	9,561	11,588	13,935	16,060	17,825	16.4%
$350,000+	14,609	17,416	19,539	22,084	24,802	27,694	13.6%
Total	$24,588	$29,538	$34,705	$40,828	$46,986	$52,923	16.6%

Source: InfoCorp

TABLE 2
WORLDWIDE ON-LINE TRANSACTION PROCESSING MARKET
UNITS CONSUMED
(THOUSANDS OF UNITS)

ASP	1981	1982	1983	1984	1985	1986	CAGR '81-86
<$50,000	4.0	5.8	8.4	16.1	27.9	30.9	50.8%
$50,000-$349,999	12.5	16.4	23.2	31.7	34.8	33.9	22.1%
$350,000+	1.8	2.4	3.3	4.5	5.5	5.9	27.1%
Total	18.2	24.6	34.9	52.3	68.2	70.6	31.1%

ASP	1986	1987	1988	1989	1990	1991	CAGR '86-91
<$50,000	30.9	50.7	78.6	112.1	147.4	180.5	42.4%
$50,000-$349,999	33.9	42.1	54.3	70.0	82.7	93.5	22.5%
$350,000+	5.9	6.7	7.5	8.6	9.7	10.7	12.8%
Total	70.6	99.5	140.5	190.7	239.8	284.7	32.2%

Source: InfoCorp

TABLE 3
UNITED STATES ON-LINE TRANSACTION PROCESSING MARKET
TOTAL VALUE
(MILLIONS OF DOLLARS)

ASP	1981	1982	1983	1984	1985	1986	CAGR '81-86
<$50,000	$99	$153	$214	$401	$704	$893	55.4%
$50,000-$349,999	1,152	1,629	2,265	3,073	3,698	3,982	28.1%
$350,000+	1,845	2,490	3,457	4,563	5,726	7,279	31.6%
Total	$3,096	$4,272	$5,937	$8,037	$10,128	$12,154	31.5%

ASP	1986	1987	1988	1989	1990	1991	CAGR '86-91
<$50,000	$893	$1,249	$1,756	$2,363	$3,012	$3,643	32.5%
$50,000-$349,999	3,982	4,679	5,623	6,617	7,508	8,218	15.6%
$350,000+	7,279	8,511	9,580	10,846	12,125	13,393	13.0%
Total	$12,154	$14,439	$16,959	$19,826	$22,644	$25,254	15.8%

Source: InfoCorp

TABLE 4
UNITED STATES ON-LINE TRANSACTION PROCESSING MARKET
UNITS CONSUMED
(THOUSANDS OF UNITS)

ASP	1981	1982	1983	1984	1985	1986	'81-86
<$50,000	1.8	2.7	4.1	8.5	15.2	17.8	57.7%
$50,000-$349,999	5.8	7.3	10.6	14.6	16.2	16.0	22.7%
$350,000+	0.8	1.2	1.6	2.3	2.9	3.1	30.8%
Total	8.4	11.2	16.3	25.3	34.3	36.9	34.5%

ASP	1986	1987	1988	1989	1990	1991	CAGR* '86-91
<$50,000	17.8	26.2	40.4	57.5	75.4	92.2	39.0%
$50,000-$349,999	16.0	20.1	25.4	31.7	37.0	41.3	20.9%
$350,000+	3.1	3.5	3.9	4.4	4.9	5.3	11.6%
Total	36.9	49.8	69.7	93.6	117.3	138.8	30.4%

Source: InfoCorp

TABLE 5
WORLDWIDE ON-LINE TRANSACTION PROCESSING MARKET
SMALL-SCALE SYSTEMS PRICED LESS THAN $50,000

MANUFACTURER	1981	1982	1983	1984	1985	1986	1986
UNITS CONSUMED							
IBM	1,927	2,980	3,380	7,550	14,393	14,183	45.9%
Digital Equipment	498	688	974	1,664	3,225	3,641	11.8%
Altos	0	0	146	317	688	1,319	4.3%
Micro Five	0	0	0	0	42	1,190	3.9%
AT&T	0	0	0	220	647	1,130	3.7%
Hewlett-Packard	90	104	160	102	516	803	2.6%
Kienzle	0	0	0	356	774	800	2.6%
NEC	439	472	601	786	1,005	775	2.5%
Convergent Tech.	0	0	72	420	315	553	1.8%
NCR	0	0	49	141	582	518	1.7%
Other	1,004	1,602	2,970	4,548	5,705	5,968	19.3%
Total	3,958	5,846	8,352	16,104	27,892	30,880	100.0%
TOTAL VALUE (MILLIONS OF DOLLARS)							
IBM	$115	$180	$215	$388	$694	$781	47.7%
Digital Equipment	22	35	50	90	171	217	13.2%
AT&T	0	0	0	5	19	60	3.6%
Hewlett-Packard	5	6	7	6	29	54	3.3%
NEC	20	25	35	36	44	47	2.8%
Altos	0	0	3	8	21	44	2.7%
Kienzle	0	0	0	13	33	39	2.4%
Triad	7	8	10	21	38	37	2.3%
Micro Five	0	0	0	0	1	34	2.1%
Texas Instruments	0	1	12	32	39	30	1.8%
Other	49	78	129	197	261	297	18.2%
Total	$217	$332	$462	$797	$1,350	$1,638	100.0%

Source: InfoCorp

TABLE 6
UNITED STATES ON-LINE TRANSACTION PROCESSING MARKET
SMALL-SCALE SYSTEMS PRICED LESS THAN $50,000

MANUFACTURER	1981	1982	1983	1984	1985	1986	1986
UNITS CONSUMED							
IBM	1,156	1,788	2,028	4,450	8,442	8,311	46.7%
Digital Equipment	299	412	587	1,012	2,036	2,328	13.1%
Altos	0	0	109	221	462	934	5.3%
AT&T	0	0	0	176	518	904	5.1%
Micro Five	0	0	0	0	25	714	4.0%
Convergent Tech.	0	0	54	315	236	479	2.7%
Triad	99	93	129	313	537	420	2.4%
Hewlett-Packard	54	47	72	45	253	401	2.3%
Data General	0	0	0	0	30	333	1.9%
NCR	0	0	26	77	319	284	1.6%
Other	216	404	1,053	1,892	2,355	2,672	15.0%
Total	1,824	2,744	4,058	8,501	15,213	17,780	100.0%
TOTAL VALUE (MILLIONS OF DOLLARS)							
IBM	$65	$103	$123	$218	$387	$435	48.8%
Digital Equipment	13	20	29	51	102	131	14.7%
AT&T	0	0	0	4	15	47	5.2%
Triad	7	8	9	20	37	35	4.0%
Altos	0	0	2	5	14	30	3.3%
Hewlett-Packard	3	3	3	3	14	26	2.9%
Texas Instruments	0	0	8	22	26	20	2.2%
Convergent Tech.	0	0	2	12	12	20	2.2%
Micro Five	0	0	0	0	1	19	2.2%
NCR	0	0	1	2	9	11	1.2%
Other	11	19	37	63	87	118	13.3%
Total	$99	$153	$214	$401	$704	$893	100.0%

Source: InfoCorp

TABLE 7
WORLDWIDE ON-LINE TRANSACTION PROCESSING
SMALL-SCALE SYSTEMS PRICED LESS THAN $50,000

MANUFACTURER	1981	1982	1983	1984	1985	1986
Total Units Consumed	3,968	5,858	8,369	16,130	27,924	30,911
UNIX Units Consumed	43	126	509	1,326	2,928	5,157
Pick Units Consumed	2	36	154	353	587	720
Unit Share - UNIX	1.1%	2.2%	6.1%	8.2%	10.5%	16.7%
Unit Share - Pick	.1%	.6%	1.8%	2.2%	2.1%	2.3%
UNIX UNITS:						
Altos	0	0	85	176	575	1,245
AT&T	0	0	0	220	648	1,130
Convergent Tech.	0	0	61	357	269	541
NCR	0	0	49	136	561	506
Other	43	126	314	437	875	1,735
UNIX SHARE %						
Altos	0.0%	0.0%	16.7%	13.3%	19.6%	24.1%
AT&T	0.0%	0.0%	0.0%	16.6%	22.1%	21.9%
Convergent Tech.	0.0%	0.0%	12.0%	26.9%	9.2%	10.5%
NCR	0.0%	0.0%	9.6%	10.3%	19.2%	9.8%
Other	100.0%	100.0%	61.7%	33.0%	29.9%	33.6%

Source: InfoCorp

TABLE 8
WORLDWIDE ON-LINE TRANSACTION PROCESSING
MEDIUM-SCALE SYSTEMS PRICED $50,000-$349,999

MANUFACTURER	1981	1982	1983	1984	1985	1986	SHARE 1986
UNITS CONSUMED							
IBM	3,580	4,424	7,074	10,177	12,650	13,150	38.8%
Nixdorf	1,439	2,400	3,000	4,208	4,172	3,964	11.7%
Digital Equipment	582	773	1,727	2,854	2,678	2,321	6.9%
Tandem	1,068	1,294	1,644	1,901	2,134	2,075	6.1%
Toshiba	104	222	415	765	1,023	1,210	3.6%
Wang Laboratories	518	762	1,072	1,252	1,296	1,177	3.5%
NCR	290	271	323	669	1,013	1,135	3.4%
Arete	0	0	2	10	347	820	2.4%
Unisys	512	609	679	597	834	615	1.8%
Prime	198	217	387	528	614	608	1.8%
Other	4,203	5,403	6,863	8,762	8,064	6,791	20.1%
Total	12,494	16,375	23,186	31,723	34,825	33,866	100.0%
TOTAL VALUE (MILLIONS OF DOLLARS)							
IBM	$945	$1,264	$1,685	$2,228	$2,880	$3,308	39.7%
Tandem	211	289	407	569	656	682	8.2%
Digital Equipment	162	207	373	597	661	681	8.2%
Nixdorf	121	205	241	299	377	394	4.7%
Wang Laboratories	97	149	213	267	305	305	3.7%
Toshiba	6	17	34	57	137	262	3.1%
Unisys	75	112	145	169	236	220	2.6%
Hewlett-Packard	81	110	128	180	200	198	2.4%
NCR	91	93	87	122	168	197	2.4%
Arete	0	0	0	1	59	160	1.9%
Other	682	1,038	1,437	1,849	2,026	1,933	23.2%
Total	$2,472	$3,484	$4,749	$6,339	$7,704	$8,341	100.0%

Source: InfoCorp

TABLE 9
UNITED STATES ON-LINE TRANSACTION PROCESSING MARKET
MEDIUM-SCALE SYSTEMS PRICED $50,000 TO $349,999

MANUFACTURER	1981	1982	1983	1984	1985	1986	SHARE 1986
UNITS CONSUMED							
IBM	1,757	2,177	3,607	5,369	6,580	6,728	42.1%
Tandem	715	880	1,116	1,291	1,451	1,410	8.8%
Digital Equipment	349	463	1,034	1,712	1,606	1,391	8.7%
Wang Laboratories	335	494	695	813	841	764	4.8%
Arete	0	0	2	10	312	737	4.6%
NCR	129	126	174	366	555	624	3.9%
Unisys	335	374	409	333	451	333	2.1%
Prime	120	128	222	305	340	329	2.1%
AT&T	0	20	35	143	199	283	1.8%
Hewlett-Packard	153	193	222	345	367	275	1.7%
Other	1,862	2,423	3,109	3,863	3,496	3,121	19.5%
Total	5,755	7,278	10,625	14,550	16,198	15,995	100.0%
TOTAL VALUE (MILLIONS OF DOLLARS)							
IBM	$433	$582	$782	$1,045	$1,341	$1,524	38.3%
Tandem	137	188	266	375	433	450	11.3%
Digital Equipment	92	118	212	338	376	388	9.7%
Wang Laboratories	61	94	134	168	191	192	4.8%
Arete	0	0	0	1	52	142	3.6%
Unisys	45	63	80	92	124	116	2.9%
NCR	40	41	42	62	87	103	2.6%
Hewlett-Packard	40	54	62	87	97	96	2.4%
Data General	22	38	48	92	102	88	2.2%
Honeywell	34	38	35	52	74	77	1.9%
Other	249	414	603	760	820	806	20.2%
Total	$1,152	$1,629	$2,265	$3,073	$3,698	$3,982	100.0%

Source: InfoCorp

TABLE 10
WORLDWIDE ON-LINE-TRANSACTION PROCESSING
MEDIUM-SCALE SYSTEMS PRICED $50,000 TO $349,999

MANUFACTURER	1981	1982	1983	1984	1985	1986
Total Units Consumed	12,510	16,397	23,214	31,748	34,854	33,893
UNIX Units Consumed	4	48	215	558	1,078	1,601
Pick Units Consumed	524	565	592	806	597	518
Unit Share - UNIX	0.0%	0.3%	0.9%	1.8%	3.1%	4.7%
Unit Share - Pick	4.2%	3.4%	2.6%	2.5%	1.7%	1.5%
UNIX UNITS:						
Arete	0	0	2	7	226	533
AT&T	0	20	35	170	238	339
Computer Consoles	0	0	9	39	136	185
Other	4	28	169	342	478	544
UNIX SHARE %						
Arete	0.0%	0.0%	0.9%	1.3%	21.0%	33.3%
AT&T	0.0%	41.7%	16.3%	30.5%	22.1%	21.2%
Computer Consoles	0.0%	0.0%	4.2%	7.0%	12.6%	11.6%
Other	100.0%	58.3%	78.6%	61.3%	44.3%	34.0%

Source: InfoCorp

TABLE 11
WORLDWIDE ON-LINE TRANSACTION PROCESSING
MEDIUM-SCALE SYSTEMS PRICED $50,000 to $350,000

	1981	1982	1983	1984	1985	1986	SHARE CHANGE 81-86 (%)
IBM Market Share:							
Total Value	38.2%	36.3%	35.5%	35.2%	37.4%	39.7%	1.4%
Units Consumed	28.7%	27.0%	30.5%	32.1%	36.3%	38.8%	10.2%
DEC Market Share:							
Total Value	6.6%	5.9%	7.9%	9.4%	8.6%	8.2%	1.6%
Units Consumed	4.7%	4.7%	7.4%	9.0%	7.7%	6.9%	2.2%

Source: InfoCorp

TABLE 12
WORLDWIDE ON-LINE TRANSACTION PROCESSING MARKET
LARGE-SCALE SYSTEMS PRICED $350,000 AND HIGHER

MANUFACTURER	1981	1982	1983	1984	1985	1986	SHARE 1986
UNITS CONSUMED							
IBM	1,058	1,426	1,931	2,192	2,528	2,430	41.4%
Digital Equipment	7	33	64	195	518	836	14.3%
Unisys	268	371	385	511	439	598	10.2%
Fujitsu	72	75	137	248	317	343	5.9%
Hitachi	43	58	177	238	262	296	5.0%
Data General	0	0	36	129	142	222	3.8%
Prime	9	18	57	178	436	220	3.8%
Bull	120	90	90	105	120	135	2.3%
NCR	75	47	76	83	85	93	1.6%
Tandem	0	0	0	0	0	90	1.5%
Other	118	266	396	573	649	600	10.2%
Total	1,770	2,384	3,349	4,452	5,496	5,863	100.0%
TOTAL VALUE (MILLIONS OF DOLLARS)							
IBM	$2,598	$3,427	$4,698	$5,614	$6,705	$8,545	58.5%
Unisys	624	804	843	1,191	1,524	1,924	13.2%
Fujitsu	125	149	305	390	531	798	5.5%
Digital Equipment	18	32	54	129	392	787	5.4%
Hitachi	43	76	208	353	476	672	4.6%
Amdahl	170	171	311	346	387	419	2.9%
Prime	5	11	36	119	313	221	1.5%
Honeywell	36	49	80	130	161	171	1.2%
Tandem	0	0	0	0	0	159	1.1%
NCR	102	86	120	143	153	158	1.1%
Data General	0	0	16	63	82	134	0.9%
Bull	78	75	77	88	99	111	0.8%
Other	103	170	248	344	437	510	3.5%
Total	$3,902	$5,047	$6,995	$8,909	$11,259	$14,609	100.0%

Source: InfoCorp

TABLE 13
UNITED STATES ON-LINE TRANSACTION PROCESSING MARKET
LARGE-SCALE SYSTEMS PRICED $350,000 AND HIGHER

MANUFACTURER	1981	1982	1983	1984	1985	1986	SHARE 1986
UNITS CONSUMED							
IBM	547	769	1,079	1,270	1,414	1,334	43.2%
Digital Equipment	4	20	37	117	329	540	17.5%
Unisys	163	228	236	324	269	359	11.6%
Data General	0	0	24	87	96	150	4.9%
Prime	5	10	34	114	264	132	4.3%
Hitachi	0	3	38	60	67	75	2.4%
Wang Laboratories	0	0	0	0	41	72	2.3%
Stratus	0	0	0	29	58	72	2.3%
Concurrent	0	0	0	0	43	62	2.0%
Tandem	0	0	0	0	0	61	2.0%
Other	89	148	199	284	288	231	7.5%
Total	808	1,178	1,647	2,285	2,869	3,088	100.0%
TOTAL VALUE (MILLIONS OF DOLLARS)							
IBM	$1,276	$1,749	$2,476	$3,052	$3,594	$4,512	62.0%
Unisys	361	484	515	745	941	1,168	16.0%
Digital	11	19	32	74	237	485	6.7%
Amdahl	103	103	189	218	232	248	3.4%
Hitachi	0	10	52	104	133	157	2.2%
Prime	3	6	20	73	182	127	1.7%
Tandem	0	0	0	0	0	105	1.4%
Honeywell	20	27	42	69	85	90	1.2%
Data General	0	0	11	41	53	87	1.2%
NCR	45	39	49	69	78	81	1.1%
Other	26	53	70	119	191	219	3.0%
Total	$1,845	$2,490	$3,457	$4,563	$5,726	$7,279	100.0%

Source: InfoCorp

TABLE 14
WORLDWIDE ON-LINE TRANSACTION PROCESSING
SYSTEMS PRICED GREATER THAN $1,750,000
TOTAL VALUE (MILLIONS OF DOLLARS)

MANUFACTURER	1981	1982	1983	1984	1985	1986	1986 Share
IBM	$1,559	$2,054	$3,029	$3,302	$3,744	$5,414	64.7%
Unisys	415	486	530	706	1,027	1,269	15.1%
Fujitsu	65	71	199	224	296	491	5.9%
Amdahl	158	155	302	342	385	418	5.0%
Hitachi	0	21	69	149	213	297	3.5%
Tandem	0	0	0	0	0	159	1.9%
Honeywell	11	15	32	80	121	141	1.7%
NEC	0	0	11	20	33	69	0.8%
NCR	0	0	15	42	65	62	0.7%
ICL	9	15	17	13	33	54	0.6%
Total	$2,217	$2,817	$4,204	$4,878	$5,911	$8,374	

Source: InfoCorp

INDUSTRY SERVICE

Industry Service is published by Gartner Group for subscribers to the Industry Service program.

February 27, 1987

Strategic Analysis Report
J. Weil

ONLINE TRANSACTION PROCESSING AND FAULT-TOLERANT SYSTEMS

Management Summary

Revenues in the online transaction processing (OLTP) hardware market should improve more than 15 percent in 1987 to $29 billion, and we expect growth over the next five years to average about 17 percent. (We estimate that worldwide computer industry revenue growth will be only about 10 percent in 1987.) Fault tolerance is a feature of some OLTP systems, and can be considered a submarket. Fault-tolerant systems provide hardware redundancy, fault detection and isolation, reconfiguration/recovery, and automatic restart and repair. Revenue growth in the fault-tolerant systems submarket should exceed 33 percent in 1987, reaching $1.4 billion. Over the next five years, Tandem Computers and Stratus Computer, early pioneers in the fault-tolerant systems area, will face stiffer competition from and lose market share to IBM, NCR, Digital Equipment Corp. and others. Tandem and Stratus will continue, however, to gain overall OLTP market share.

Users should not be led astray by price/performance when selecting an OLTP system, since systems often show a wide range in price/performance depending on the given applications throughput. Application growth and system expandability should also be key concerns. In general, price/performance in 1986 (as measured by ET-1 benchmarks) was about $20,000-$25,000/transactions per second (based on the average price of a nominally configured system, including hardware and system software). We expect both hardware and software improvements to yield at least a 15 percent annual improvement in that figure over the next four to five years.

GARTNER GROUP, INC.

Industry Service is published by Gartner Group, Inc. Reprints of this document are available for $25 prepaid. Multiple reprint prices are available upon request. Entire contents © 1987 by Gartner Group, Inc. 72 Cummings Point Road, Stamford, CT 06902. Telephone: (203) 964-0096. Facsimile: Extension 206. Telex: 643528.

CONTENTS

Introduction

The migration from batch to online applications in the late 1970s and early 1980s produced for most users annual growth in mainframe CPU capacity requirements of 30 percent to 40 percent. The current superior price/performance of minicomputers and microcomputers is one of the reasons applications have migrated from mainframes to minis and micros. That migration is why (along with poor applications development facilities) growth in mainframe CPU capacity requirements has slowed. Online applications growth is not tapering, however; we expect capacity growth requirements for online applications to accelerate from 30 percent-40 percent to about 50 percent over the next five years -- led by financial services requirements, as well as applications in the point-of-sale, communications and distribution areas.

Growth in capacity requirements in batch processing over the next five years will be slower than those in OLTP, averaging 17 percent (see Figure I). By 1992, therefore, online processing MIPS at a typical commercial site will account for about 68 percent of total installed processor capacity, while batch processing will be only about 8 percent (down from 40 percent in 1980).

Figure I

Installed MIPS at a Typical Commercial Site

	1986	CAGR 86/80	1986	CAGR 92/86	1992
System	1.4	43%	12.0	43%	103.4
Batch	3.1	28%	13.7	17%	34.5
DB/DC and Interactive	3.3	46%	31.4	45%	293.1
Total	7.8	40%	57.1	40%	431.0

Many of these applications will be aimed at serving the front office, thereby increasing their importance to the top line of the user firm. Accordingly, there will be a need for systems that ensure continuous operations. The success of vendors such as Tandem and Stratus in the fault-tolerant arena serves as testimony not only to this phenomenon, but also to the failure of fault-tolerant systems from vendors such as IBM and DEC to address users' needs adequately. We expect, however, that vendors such as IBM and DEC that are eyeing developments in the OLTP market will announce products aimed at this market. Just in the last several years, IBM has made several significant moves to address user needs for higher availability (with, for example, the System/88 and the Extended Recovery Facility). We also expect DEC to introduce software and hardware that will be better designed to handle fault-tolerant OLTP applications.

Users designing and developing such applications must consider a number of key issues in evaluating an OLTP system. Beyond the more routine considerations of throughput, price/performance, maintainability and reliability are issues of software (applications development, applications availability) and networking (local-area network

support, Systems Network Architecture/LU6.2 integration and PC synergy). More important among large corporations, we believe, will be concerns about distributed OLTP and distributed database management system (DBMS) capabilities.

A wide range in price/performance exists among different vendors' products (and even within the products of a single vendor). While we expect annual price/performance improvements to average 15 percent to 20 percent, some products (such as IBM's DB2) will have considerably better improvements. Moreover, price/performance is not static. Many products show a range of price/performance depending on the applications throughput. Some products (such as IBM's DB2 and CICS with IMS/DB) display superior price/performance for applications with low throughputs, while other products (such as IBM's Transaction Processing Facility) are more economical for very high throughputs.

Users also must consider absolute system performance levels. Current products provide a wide range of performance. Present and future applications requirements must be contrasted with present product performance and the prospects for future improvement. The ability to provide linear growth, as Tandem, Stratus, NCR and Tolerant have done with their modular architectures, is certainly a plus.

As it becomes increasingly important to link transaction processing networks, issues of networking, distributed OLTP and distributed database management take on much greater significance. Most vendors have provided at least one type of local-area network support; however, to be able to serve a variety of environments (such as the office and factory), systems must support a number of media and protocols. To interface with IBM's SNA, most vendors are adopting IBM's LU6.2 peer-to-peer communication protocols. Also important in the next several years will be the ability to provide cooperative transaction processing across a hierarchy of computing. Vendors must therefore develop distributed DBMSs. In our opinion, only Tandem has demonstrated a truly distributed DBMS with acceptable OLTP performance, although third-party software vendors, such as Ingres and Relational Technology, have developed distributed DBMSs for the IBM environment. The difficulty in developing such systems lies in assuring data integrity and transaction recovery. Presently, distributed DBMSs (such as Tandem's) do not fully address all of these issues. We expect a major push in this area to produce a number of distributed DBMSs over the next three to five years; performance will be a key issue.

New Industries and New Applications Will Drive Market Growth

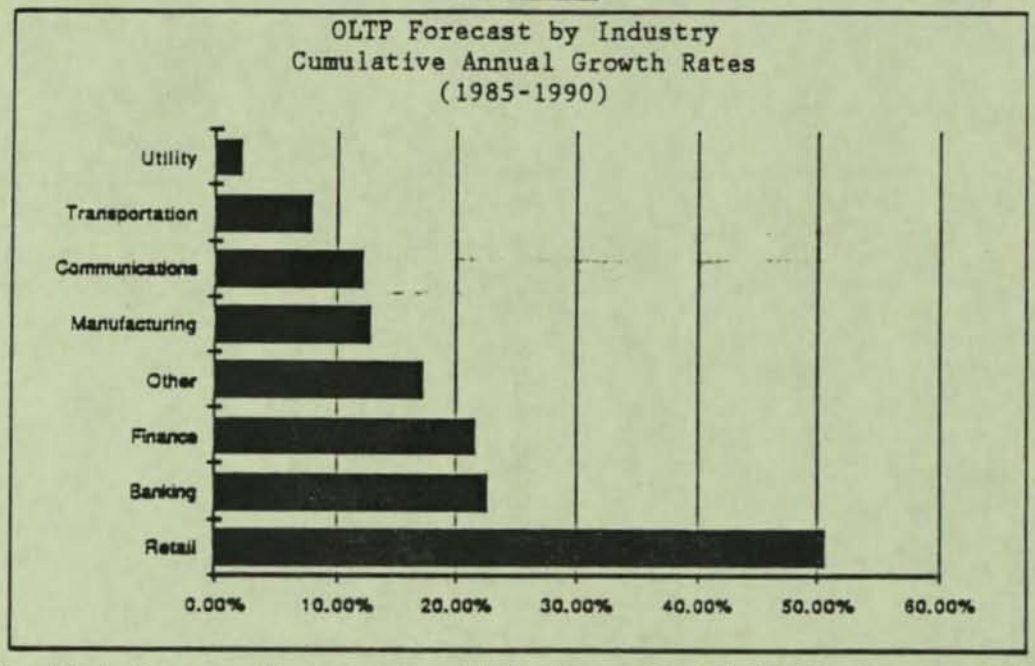
Online transaction processing refers to a variety of applications that involve the concurrent online sharing of common databases by multiple users. The airline industry pioneered OLTP systems in the 1960s with Sabre, developed to handle reservation systems. The automobile rental and hotel reservation industries followed suit a decade later with major OLTP systems. In the 1970s, many companies began migrating their back-office applications (such as payroll and accounting) to online systems. For the first time, growth in online capacity requirements exceeded that in batch applications.

Other industries in the mid-1970s started following the lead of the airline, auto and hotel industries in developing online applications for front-office activities. Companies automated their sales, marketing and manufacturing operations. In recent

years, the banking and financial industries have been leaders in the growth of such systems with their debit/credit and electronic funds transfer applications.

We expect the banking and financial industries over the next five years to continue to generate strong demand for OLTP systems. We estimate that annual revenue growth of applications in those areas will average 21 percent to 22 percent. In addition, strong sales of retail (point-of-sale) and manufacturing (computer-integrated manufacturing, just-in-time) applications should add to the growth in OLTP (see Figure II).

Figure II

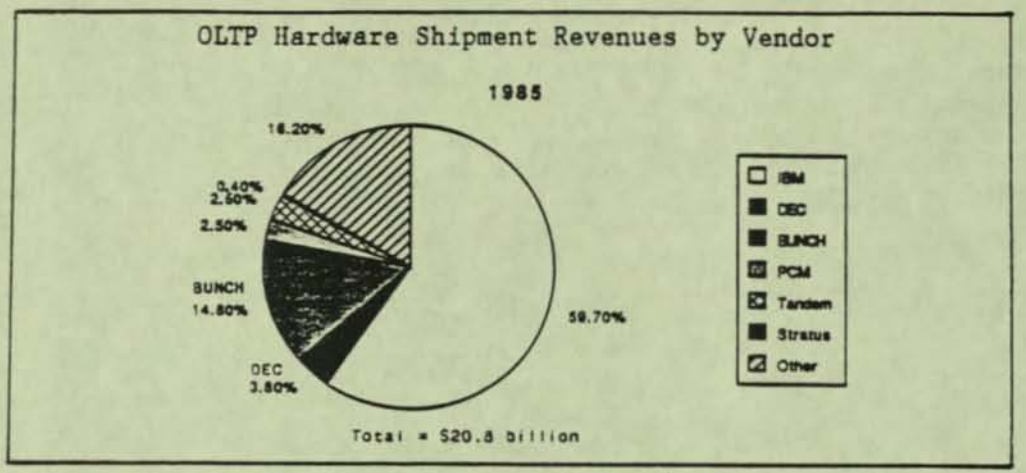


We estimate that the retail segment, which is small ($1 billion) compared with the banking ($7 billion), financial ($4 billion) and manufacturing ($7 billion) segments will show a 50 percent CAGR between 1985 and 1990. The non-durable manufacturing segment, we estimate, will provide a 17 percent CAGR in OLTP revenues. In the case of manufacturing companies, early efforts to introduce computer-integrated and just-in-time manufacturing have met with limited success, primarily because of a lack of equipment interoperability among vendors. With the expected introduction this year of MAP 3.0 protocols (which will place tighter controls over intervendor communications), and with efforts by the Corporation for Open Systems (COS) to ensure compliance with the MAP 3.0 standard, users should have greater success implementing automated manufacturing systems. As this comes to fruition over the next 12 to 18 months, the stage finally will be set for manufacturers to adopt these technologies.

Migration from Monolithic Mainframes to Distributed Databases Will Improve Market Share of Today's Smaller Competitors

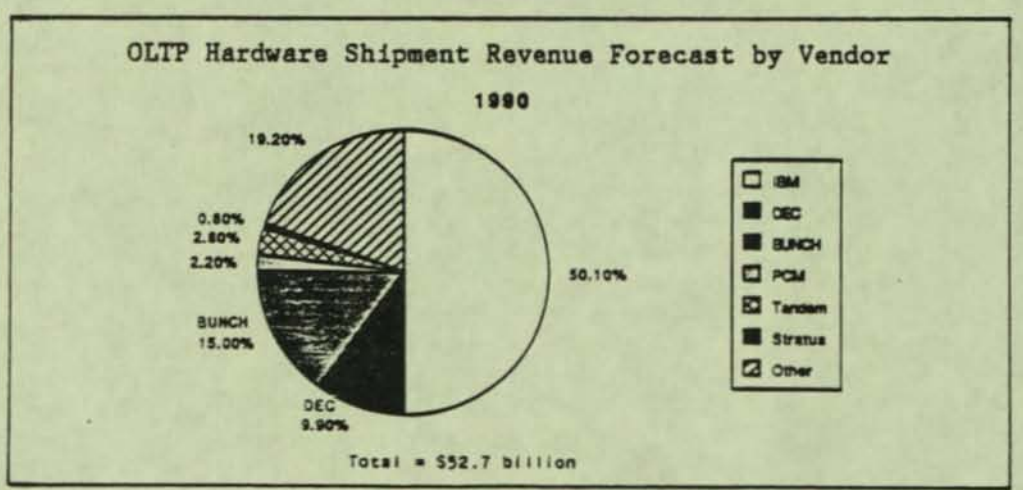
OLTP has become ubiquitous; most computer vendors participate to some extent. The 1985 value of the OLTP market in terms of worldwide mainframe and minicomputer hardware shipments was about $21 billion (see Figure III).

Figure III



IBM was the market leader, with almost 60 percent market share. Burroughs and Sperry (now merged as Unisys), NCR, Honeywell and Control Data had in total about 15 percent of the market. Minicomputer vendors had a small portion: DEC had about 4 percent market share, Tandem 2.6 percent and Stratus 0.4 percent. Over the next four to five years, however, developments in distributed database technology should enable minicomputers and superminis (through networked topologies) to handle many OLTP applications that currently are run on mainframes. As a result, minicomputer vendors, in particular DEC, should capture a larger share of OLTP CPU hardware shipments in 1990 (see Figure IV). We expect 60 percent to 70 percent of the minicomputer capacity shipped in 1990 to be used for OLTP applications.

Figure IV



Fault-tolerance is often considered a market, but it really is only a system attribute (see Figure V).

Figure V

Requirements of a
Fault-Tolerant System

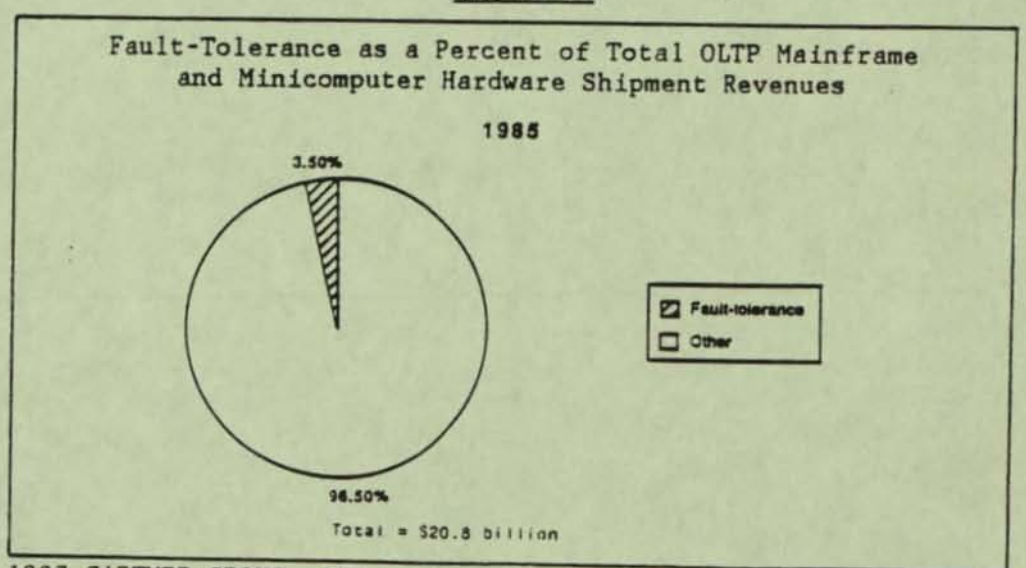
- Hardware redundancy
- Fault detection
- Fault isolation
- Reconfiguration/recovery
- Automatic restart
- Online repair

Other Key Requirements

- Dual ported peripherals
- Disk mirroring or shadowing
- Multiple processors
- Message-based operating system
- Continuous operation
- Modular expansion

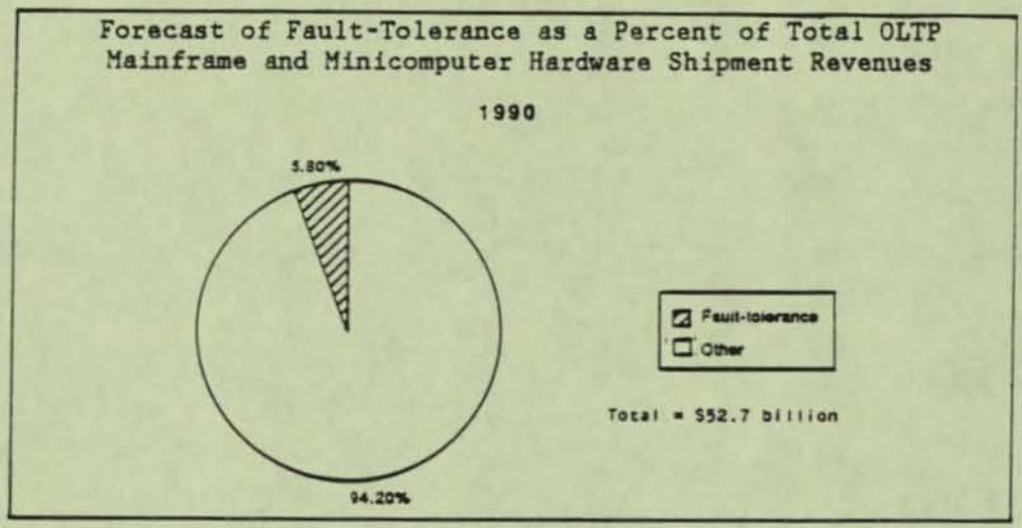
The need for high availability has been particularly keen in the areas of finance and banking and has been largely responsible for the success of Tandem and Stratus. Placed within the greater context of OLTP, however, 1985 hardware shipments of fault-tolerant systems represented only about 3.5 percent of the worldwide market (see Figure VI).

Figure VI



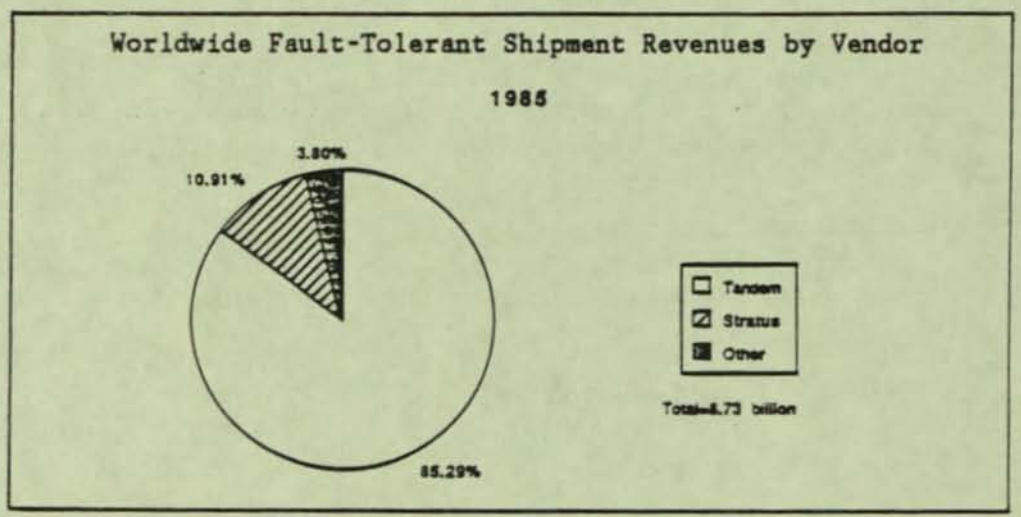
We expect demand for high-availability systems to be strong, because as more front-office applications are migrated to online computer systems, computer outages may lead to direct revenue losses. Measured as hardware shipment revenues, this area, we believe, will grow 33 percent annually over the next four to five years (see Figure VII).

Figure VII



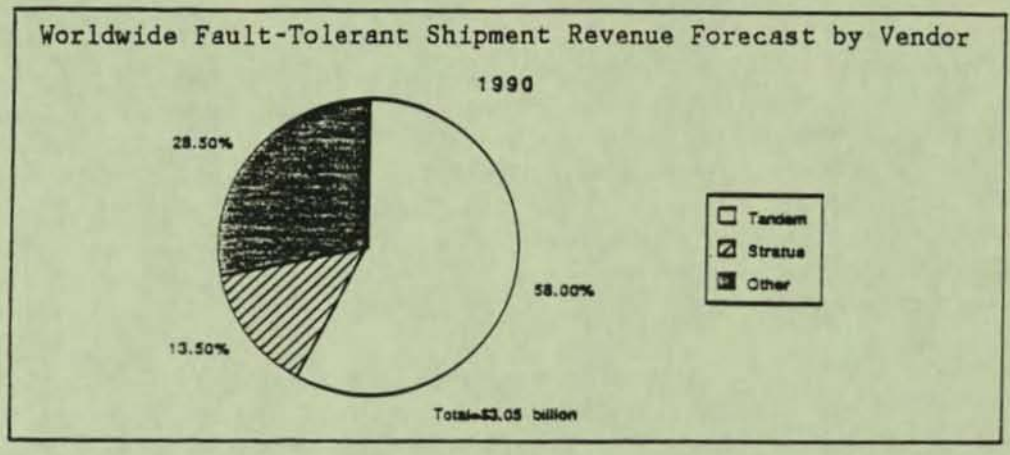
Tandem and Stratus, which in 1985 had more than 95 percent of fault-tolerant hardware shipment revenues (see Figure VIII), will continue to experience healthy revenue growth.

Figure VIII



However, other leading computer vendors, such as IBM, DEC and NCR, will also step up and address the high-availability issue. We estimate those vendors will ship almost 30 percent of the 1990 value of high-availability systems (see Figure IX), taking market share from Tandem, which we estimate will garner 58 percent of the more than $3 billion total in 1990.

Figure IX



IBM: Something for Everyone

IBM's involvement with OLTP goes back more than 30 years. Its Airline Control Program (ACP) was an early, but large and highly complex OLTP application developed in the late 1950s to serve the airline reservation industry. Although it now sports a different name -- the Transaction Processing Facility (TPF) -- the product has continued to serve the needs of the very high transaction processing marketplace. Capable of supporting transaction throughput rates above 1,000 transactions per second (tps) in a multiple CPU configuration, TPF is used in the airline, automobile and hotel industries to handle reservation systems. At least one large banking concern in the United States (the Bank of America) is using TPF. Still, we estimate the number of TPF (ACP) users is only about 150, largely because TPF, which is optimized for high throughput, lacks certain functions/features (such as security, recovery, maintainability and program development facilities) that users consider critical for many applications.

To serve a broad spectrum of smaller-scale applications, therefore, IBM has developed several other products: IMS Fastpath, IMS/DC and CICS. Together, these products provide a range of performance to serve applications operating at less than 25 tps to those operating above 1,000 tps. However, we believe IBM would like to consolidate the number of products serving this market. What, then, are the future prospects for TPF, IMS and CICS?

TPF, IMS/DC or CICS?

Given the small number of TPF users, the difficulty of finding qualified programmers, and the prospects for IMS, we believe IBM will place less effort on future developments for this product. While we do not expect IBM to abandon TPF, we believe users wanting major modifications may have to make many of them themselves.

A large part of IBM's de-emphasis of TPF, we believe, comes from the notion (which we believe has been fostered within the company) that IMS' performance can be enhanced to serve the very high end of the market; that is, even above 1,000 tps. In accordance with this notion, we believe IBM would then be able to pare down its OLTP offerings, consolidating to two -- IMS for high- to very high-end OLTP applications needs, and

CICS for the low- to high-end OLTP range. (We estimate there are about 3,000 IMS/DC users and 26,000 CICS users.)

In addition to providing security through such features as RACF, these products, we believe, will also offer a greater measure of data integrity. IBM's Extended Recovery Facility (XRF), presently announced for IMS (but we believe CICS will be supported in mid-1988) provides an element of fault-tolerance. XRF enables a second CPU complex to shadow the transactions of the principal application by maintaining a log record along with check points of every step being carried out by the primary CPU. This is a very expensive solution (it requires a "hot" 3090/308X), yet it is the only S/370 quasi-fault-tolerant solution.

A third product that we believe IBM will continue to market for OLTP environments is the System/88. IBM has targeted the product, which it OEMs from Stratus, primarily at low-end (low transaction rate) applications that require a high degree of availability. At the outset, we faulted the S/88 for not providing good SNA connectivity, but since the OEM agreement between IBM and Stratus was announced, several products (Primary SNA, Secondary SNA and LU6.2) have been delivered that resolve most of the issues. While the development of these products was conducted by IBM, its involvement with the S/88 remains primarily that of a remarketer. We believe IBM will continue to push the S/88 in niche applications, and that its principal thrust over the next four to five years will remain with the S/370-based products (309X, 43XX and 937X).

Tandem: Where to from Here?

The need for very high availability in certain OLTP applications has been the key to Tandem's success, but the company's recent growth (1986 revenue was up 23 percent year-to-year to $768 billion) has been fueled equally by its products' price/performance, linear growth capabilities and high transaction throughput.

Since IBM only recently began to address the high availability issue, Tandem has been able to penetrate the banking, retail and manufacturing industries for applications such as debit/credit (automated teller machines), point of sale (POS) and materials resource planning (MRP). Tandem had approximately 3,000 CPUs installed at year-end 1985.

Tandem's Nonstop (EXT, TXP and VLX) series of computers employs checkpoint/restart software and mirrored disks to provide a high degree of system availability. Early Nonstop products were aimed at transaction volumes greater than 10 tps, giving Stratus an opportunity to strike at the low end of the OLTP market. Tandem recently began to stretch its product line. It introduced the EXT (low-end) and VLX computers in 1986, extending the performance spectrum of the Nonstop series from less than 10 tps to more than 100 tps (see Figure X).

Figure X

Tandem Nonstop Systems

	EXT 10	EXT 25	Nonstop II	Nonstop TXP	Nonstop VLX
No. of Processors	2-4	2-4	2-16	2-16	4-16
Main Memory	32 MB	64 MB	128 MB	256 MB	256 MB
TPS (min.)	4.3	11	4	11	40
Entry Price	$82,500	$325,000	$155,000	$399,000	$995,275

We believe Tandem's software is the primary reason for its market leadership. In particular, Tandem has for years offered IBM SNA support (PU2, PU4 and LU6.2) in addition to its own networking capabilities. What really places Tandem ahead of its competitors, though, is its demonstrated distributed DBMS capabilities.

We expect Tandem to continue to expand its range of performance over the next four to five years. At the high end, performance should reach 500-1,000 tps by 1990. In the field, Tandem has already demonstrated it can successfully handle applications with throughputs over 100 tps. Near term, we expect a new low-end CMOS-based system in 1987, and a new DBMS that will support the IBM Structured Query Language de facto standard.

Stratus: In Hot Pursuit

The emergence of Stratus, like that of Tandem, was due to a market requirement for small systems with high availability that could handle 3-10 tps. Stratus' success is marked by its 152 percent annual revenue growth between 1982 and 1985. Stratus' 1986 revenue increased 55 percent to $125 million. We estimate Stratus had approximately 500 units installed worldwide at year-end 1985.

Stratus' approach to high availability, however, is different from Tandem's approach. Stratus uses the pair and a spare technique (based on the Motorola 680X0 microprocessor) to duplicate system hardware fully, yielding very high availability. The company's new line of computers (the XA2000 Series) offers performance that stretches from about 5 tps to about 50 tps (see Figure XI). Price/performance is comparable to that offered by Tandem and other fault-tolerant vendors, between $15,000 and $30,000 per tps.

Figure XI

Stratus XA2000 Series

	Model 100	Model 110	Model 120	Model 130	Model 140
Number of Processors	16	2	4	6	8
Main Memory (min./max.)	4/64 MB	8/64 MB	8/64 MB	8/64 MB	8/64 MB
TPS (min.)*	14	15	28	40	50
Entry Price	$310,000	$260,000	$340,000	$430,000	$750,000

Stratus/32 Continuous Processing Systems

	FT 250	XA 400	XA 600
Number of Processors	2	4	6
Main Memory (max.)	64 MB	64 MB	64 MB
TPS (min.)*	5	10	15
Entry Price	$95,000	$211,000	$310,000

* Stratus estimates, based on ET-1 benchmark

Stratus announced a number of products in 1986 aimed at dealing with criticism that it lacked links to SNA. Primary SNA enables a Stratus computer to function as an SNA host device. Secondary SNA allows a Stratus system to connect to SNA networks as a cluster controller. Advanced Program-to-Program Communication allows Stratus applications to communicate with other SNA applications via Synchronous Data Link Control and LU6.2 protocols. A fourth program product, Communications and Systems Management, enables Stratus systems to participate in SNA network management and control by feeding error information to IBM products such as Network Problem Determination Application (NPDA).

Stratus recently introduced the XA2000 series, a follow-on to its 68010-based generation of CPUs that will utilize newer Motorola 68020 microprocessors. The top-of-the-line XA2000 model 140 reportedly has a throughput of 50 tps and a price/performance of only $15,000/tps (based on ET-1 benchmarks).

Although Stratus' applications development facilities are perhaps superior to those of its competitors, its DBMS software is somewhat lacking. As far as performance is concerned, Oracle's DBMS, which runs on Stratus, is outpaced by some of the competition. Further, neither Stratus nor a third party currently offers a distributed DBMS, and though such a system will probably exist someday, we do not expect announcement of one for at least 12 to 18 months. We believe that beyond 1987, Stratus will continue to increase the maximum performance of its systems. With the incorporation of the Motorola 68030 microprocessor, probably in 1989, maximum performance should extend well above 100 tps.

Digital Equipment Corp.

DEC's principal focus has been in the scientific and engineering environments; its VAX architecture was optimized for computationally intensive applications. However, commercial data processing applications tend to be more input/output intensive. DEC's

new BI bus supports data transfer rates of 33 Mbytes per second; thus, DEC is moving to address application requirements in commercial environments. As users implement more critical applications online, DEC (like IBM), will have to do a better job addressing the high-availability issue if it hopes to compete successfully. VMS, DEC's primary operating system, does not provide linear expandability, nor an optimized structure for handling high I/O rates, regardless of its BI bus. In addition, VMS offers limited multiprocessor support -- dual processors in a master/slave relationship. If DEC expects to provide applications throughput in the multiple hundreds of transactions per second, we believe it will need to offer true peer-to-peer multiprocessor support. More specifically, DEC must enhance VMS to provide a single-system image in a multiple CPU environment. Although VMS provides disk shadowing and automatic log recovery, it does not presently provide dynamic load balancing, which is important to success in the high-availability applications marketplace. DEC also needs a better transaction processing monitor -- like IBM's CICS. Presently, an 8600 purportedly can handle only about 10 tps maximum. Compared with the performance of a system from Stratus, Tandem, NCR or several other vendors, that places DEC's price/performance -- at about $50,000/tps -- well behind that of the competition. We believe DEC is aware of its shortcomings and is studying these issues carefully. We expect it to introduce products over the next several years aimed at improving its performance in online applications. As a first step, DEC is expected to introduce this year a new version of VMS that will allow true multiprocessor support.

War Stories from the Field

It would be impossible (or at least nearly so) to discuss the efforts and prospects of every computer vendor in the OLTP market. Certainly, most computer vendors expecting success in the commercial data processing market view OLTP as a key to future prosperity. A few comments, however, on specific vendors are in order.

NCR, which has been a leader in the retail POS arena, made a splash in 1986 when it introduced the 9800 multiprocessor-based system. The 9800, in our opinion, is an impressive machine, state-of-the-art in the integration of relational database capabilities with NCR's proprietary operating system (VRX/E). The system provides high availability through its multiprocessor architecture, dual pathing, disk shadowing and dynamic load balancing capabilities. Most impressive, perhaps, is its reported price/performance of $10,000-$15,000 per tps. Maximum performance from the proprietary microprocessors is about 30 tps for an 8-CPU configuration. Improvements to the 9800 family should increase both the number of CPUs supported in a single system and the raw performance of a single microprocessor. We are not sure whether throughput will reach 1,000 tps (for a single system) by 1991, but performance in excess of 100 tps is certainly possible.

From among the myriad of start-ups that have set their sights on the OLTP market and proposed offering high-availability systems, only a few seem to have come through the fire. Most notable perhaps is Tolerant Systems. In its wake are the failures of companies like Auragen Systems, Synapse Computer and Parallel -- to name just a few. Although Tolerant may yet achieve success, it has so far been elusive. In fact, Tolerant's experience exemplifies the barriers to entry into the OLTP market faced by new competitors.

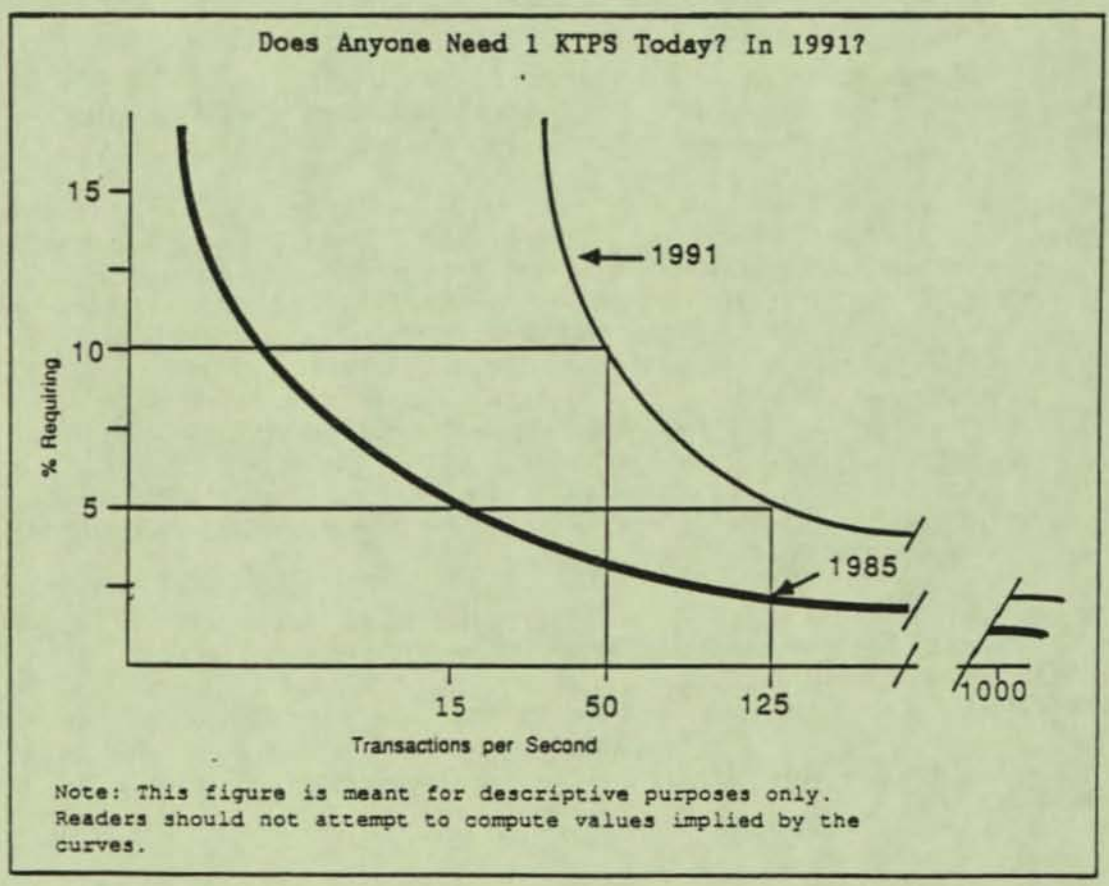
Tolerant's strategy, which pivoted on adapting Unix from a procedural-based operating system to a message-based system capable of providing fault-tolerance, reportedly cost about $10 million and 100 manyears to develop. We estimate that as of mid-1986, Tolerant had installed about 36 of its Eternity Series computers. Based on National Semiconductor's 32032 microprocessor, the P200 (or system building block -- SBB) can deliver about 8 tps. SBBs, however, theoretically can be coupled into configurations that contain more than 40 SBBs and provide a combined throughput of several hundred tps. Price/performance of about $25,000/tps is competitive with that of Tandem and Stratus.

Other vendors are recognizing Tolerant's pioneering effort at adapting Unix for this environment. The company has begun licensing its operating system (including to Honeywell and Bull) for use in the licensees' own systems.

Does Anyone Need 1,000 Transactions Per Second Today?

Although a few industries (such as the airlines and banks) have users whose applications may exceed 1,000 tps, the demands of those few users seem overstated compared with the requirements of most online applications. Our analysis shows (see Figure XII) that in 1985 more than 95 percent of applications required less than 15 tps. In fact, less than 1 percent of applications, primarily in the reservation, banking and POS areas, actually required more than 100 tps.

Figure XII

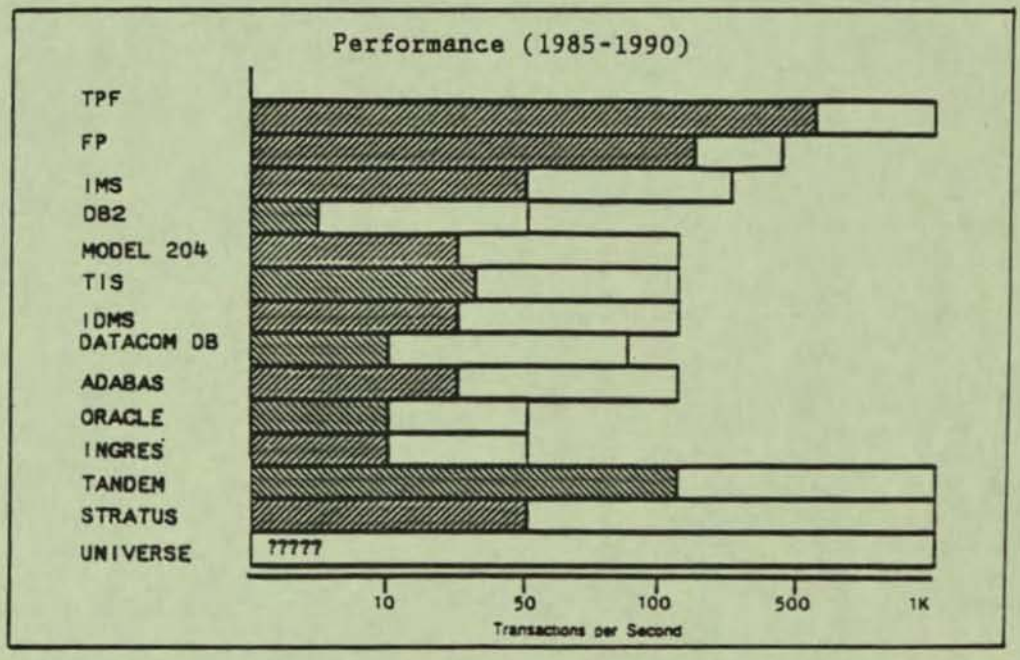


Applications demand growth, as well as mergers, acquisitions and the expansion of financial services, is driving the more than 50 percent annual increase in OLTP applications. Still, we estimate that on average, only 10 percent of applications in 1991 will require greater than 50 tps -- up from just under 1 percent in 1986. Only about 5 percent of applications will require more than 125 tps in 1991, and just 1 percent will need more than 1,000 tps.

What Will Be Peak OLTP Performance in 1990?

The list of products and vendors serving the OLTP marketplace is long. In Figure XIII we outline the maximum performance of a number of prominent products/vendors serving a similar application such as the ET-1 benchmark.

Figure XIII



IBM's TPF and IMS Fastpath, as well as Tandem's TXP, delivered peak performances in 1985 above 100 tps. TPF serves at the highest end of the marketplace. Future enhancements from IBM, however, will be limited, and performance ultimately may be driven by users' own initiatives. IMS/DC, IMS Fastpath and CICS, from our vantage, appear to be IBM's strategic thrusts at the high end; therefore, more than a twofold improvement in TPF's performance seems unlikely.

Users whose applications will require peak performance of more than 200 tps during the next four to five years, therefore, should look at systems other than those mentioned above as possible alternatives. We believe products from vendors such as Tandem and Stratus and perhaps a few others will be the principal alternatives.

For the vast majority of applications, which will require under 100 tps, users should have a wide choice of products. Third-party DBMS vendors, including Cullinet, Cincom, Software AG, Computer Corp. of America and ADR/Ameritech, should all offer S/370-based

systems with peak performance levels of about 100 tps, particularly for hierarchical DBMS products.

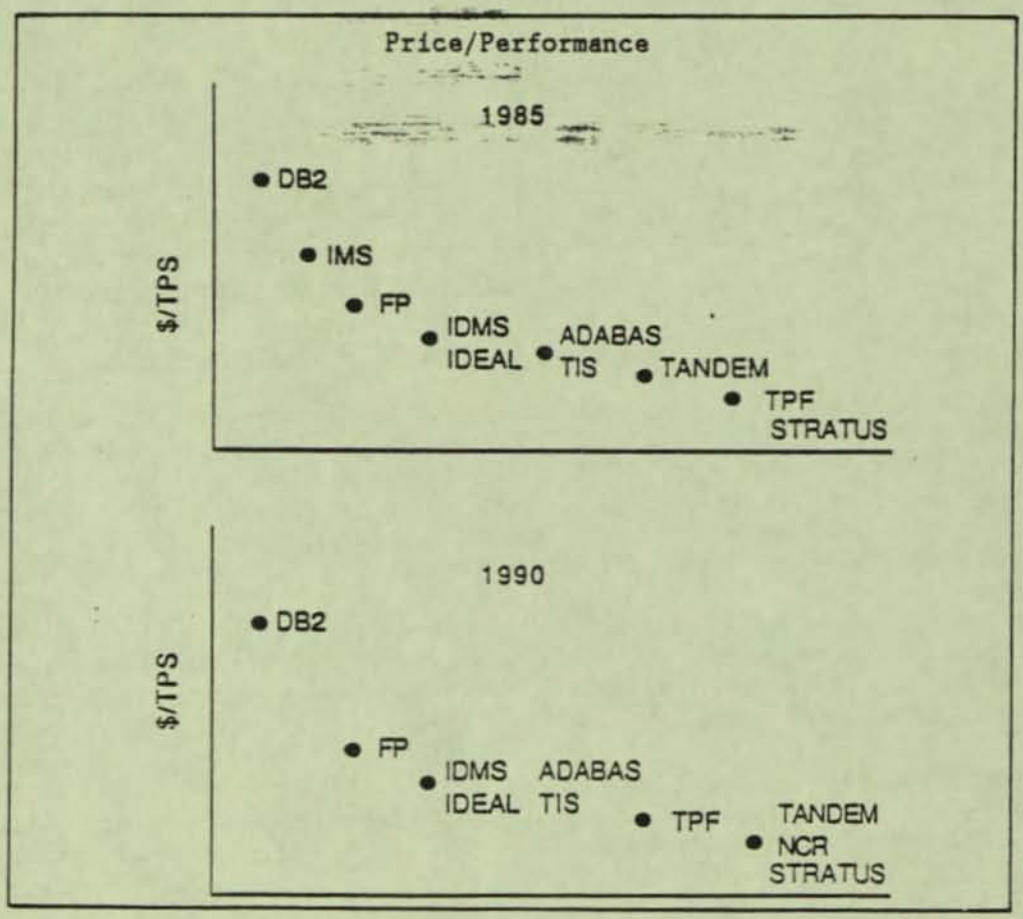
The current movement toward relational DBMS systems (DB2, Oracle, Supra, Ingres), especially in decision support applications, raises questions about performance. While we do not expect demand for these applications to reach the level of demand for such applications as POS, EFT or ATM applications, we do expect that the increased use of relational DBMSs will require peak performance levels of at least 50 tps by 1990, perhaps higher. DB2 provided peak performance in 1985 of less than 10 tps, according to Gartner Group user clients. With the introduction of release 2.0 in 1986, IBM significantly enhanced DB2's peak performance, but it still remains at less than 20 tps for most applications. We believe IBM must enhance DB2's performance further. We therefore expect a performance boost of at least 50 percent annually; within the next four years, peak performance should reach at least 50 tps.

Similarly, we expect performance enhancements of other relational DBMS products, such as those from Oracle and Ingres, with peak performance of up to 80 tps.

What About Price/Performance?

All systems are not equal. Price/performance as shown in Figure XIV often extends across a wide range.

Figure XIV



Our analysis indicates that in 1985, price/performance extended from a high of about $250,000 per tps for DB2 (running on an IBM 30XX) to a low of about $25,000-$30,000 per tps for TPF (running on a 91XX) or for systems from Tandem and Stratus. In 1986, several vendors, including NCR, announced improvements in price/performance at the low end to $15,000 per tps. Tolerant, Tandem and Stratus continue to improve price/performance. Paced by improvements in semiconductor technology and software, which will allow systems to be coupled into even larger configurations, we estimate price/performance will continue to improve 15 percent to 20 percent per year over the next four years. For such products as DB2, improvements may be even higher.

We expect there to be a wide range in price/performance in 1990. In terms of absolute dollars, price/performance should range from $50,000 per tps at the high end on products such as DB2 down to $6,000 per tps at the low end on products from such vendors as Tandem, Stratus, NCR and Tolerant.

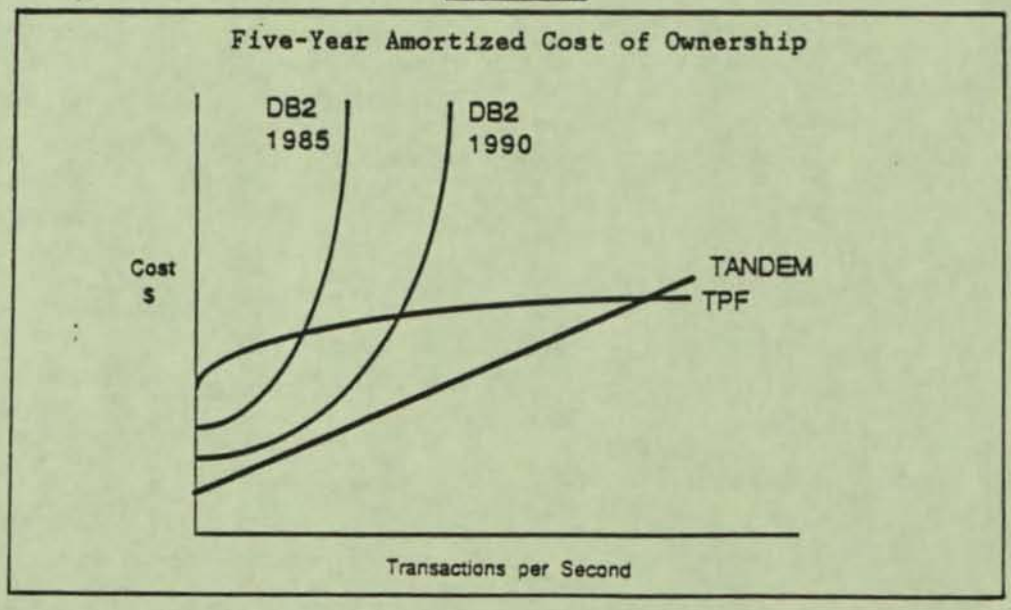
Multiprocessor architectures may offer the best hope for the most rapid OLTP price/performance improvements. They not only provide superior price/performance today, but in all probability will continue to do so. This superiority is easy to understand if one considers the nature of online transaction processing. An OLTP application is essentially a replicated set of similar processes. Therefore, like tellers at a bank or cashiers in a supermarket, multiprocessors should handle heavier demand both more rapidly and more evenly.

Price/Performance Varies With Absolute Performance

A more subtle point about price/performance is that it may not be the same for different levels of demand. In other words, price/performance for a given application may not be the same across a range of application throughputs.

In Figure XV, we show the fully burdened five-year amortized cost of ownership of IBM's TPF and DB2, as well as of a Tandem TXP computer system.

Figure XV



As the figure suggests, DB2's price/performance improves markedly with an increase in transaction volume, but after traversing only a short range of performance, further increases in performance greatly increase DB2's cost. Above a certain point, no matter how much money one throws at DB2, performance cannot be improved.

The same point becomes true as one approaches the performance limit for any product, but as shown in Figure XV, in the case of TPF, price/performance improves as one moves to higher transaction rates (at least across the range of throughputs described here).

For Tandem (as well as for Stratus, NCR or Tolerant), price/performance is relatively constant -- costs increase in a straight line with performance. Linear expandability, in our opinion, is a primary advantage to systems employing multiple processor architectures. Price/performance is a constant, but more importantly, incremental applications demand can be met through incremental additions in processing power.

Conclusion

Transaction processing lends itself to distributed architectures. Multiple processors and distributed systems will become the order of the day in five years. Software, however, is the gating factor. Operating systems that support multiple processors and distributed DBMS software are key ingredients.

OLTP applications growth, therefore, will be slanted more toward minicomputers or departmental systems than mainframes, so the 17 percent five-year CAGR in OLTP hardware revenues will largely benefit minicomputer systems vendors. We expect DEC and NCR in particular to emerge as strong players in this arena, along with Tandem and Stratus.

As OLTP applications play a greater role in companies' top-line performance, fault-tolerance will gain importance. Tandem and Stratus, the two leaders in this area, will be met by vendors such as IBM and DEC, which are also enhancing and developing products to deal with fault-tolerance.

Price/performance is quite variable, but multiprocessor systems (such as those from Tandem, Stratus and NCR) offer about the best price/performance available. Moreover, these vendors' systems offer almost linear improvements in performance at a relatively fixed price/performance. Over the next five years, annual price/performance improvements should average about 15 percent to 20 percent.

Fault tolerance

FAULT TOLERANCE LIVES

Fault-tolerant transaction processing systems are no longer found only in huge corporate systems. Costs have fallen, making fault tolerance an option even for small applications.

by Lawrence Stevens

The Boston Stock Exchange turned to a fault-tolerant OLTP system as a matter of survival, says James Crofwell, vice president of systems and finances.

Quick and reliable online transaction processing systems are spreading, and a major reason is the falling cost of fault-tolerant computers. Not too long ago, only large corporations could justify the cost of fault-tolerant systems, and the typical applications were huge—like networks of automatic teller machines. No more.

Falling hardware prices are making fault tolerance justifiable in more applications. For example, Stratus Computer Inc. put a $140,000 price tag on its FT-250 fault-tolerant machine when it debuted in late 1982. That machine now costs $95,000. Says one bank executive, "We can now buy two processors for what we would have paid for one five years ago. So in a sense, we are getting our fault tolerance free."

Fault-tolerant computers are not the only option for OLTP systems—indeed, by one estimate, 90 percent of OLTP applications reside on conventional computers—but they're probably the most important option. Fault-tolerant computers are the fastest growing kind of OLTP systems, says Jeffrey Canin, an analyst at Hambrecht & Quist, a San Francisco securities brokerage. Canin believes the most significant innovations in OLTP have been in fault-tolerant systems.

When a competitive edge is on the line, fault-tolerant computers often turn up at the heart of the system that restores it, even if the application is small. The Boston Stock Exchange, a regional exchange, recently installed two Stratus XA 600 fault-tolerant computers to run the Boston Exchange Automated Communications Order-routing Network (Beacon). Beacon replaces a microcomputer and the Quotron stock-information service, a much more limited system. The Boston Exchange is no giant, but it was compelled to move into OLTP for the same reason many larger corporations cite when installing such systems. James Crofwell, the exchange's vice president of systems and finances, says survival was at stake.

OLTP ensured that the Boston Exchange would be able to compete against other regional exchanges in an increasingly aggressive business. As late as 1980, the Boston Exchange was executing trades manually, says Crofwell, while other exchanges were automating. Buy and sell orders were taken over the phone, scribbled on paper forms, and trotted across the trading floor to specialists and brokers. Communications on the floor were at a loud volume, but the volume of trading was slipping, says Crofwell. Losses reached $100,000 a month at one point; the price for a seat on the exchange fell to $1,000. As orders slackened, specialists became increasingly reluctant to buy and sell from their own accounts.

Beacon will put the Boston Exchange into national markets, Crofwell says. The system is tied into the national network of regional stock exchanges known as the Intermarket Trading System. The Stratus XA 600s maintain a database that is constantly updated by the national system, which links specialists from all over the country. When a stock order comes into the exchange, the machine searches for the best price and flashes it on the appropriate specialist's terminal on the floor. The specialist has 15 seconds to approve the order or delay it in hopes of getting a better price. If an order is executed, it is reported back to the buying and selling brokers on the floor and to the ticker tape machine.

The Boston Stock Exchange's experience is being repeated over and over as financial institutions, retailers, oil companies, insurers, telecommunications vendors, and other businesses develop new information services either for their customers or their employees. Kimball Brown, an analyst at San Jose, CA, market researcher Dataquest Inc., estimates that 50 percent of the mainframes purchased this year will run OLTP applications, up from less than a third five years ago. He expects the percentage to keep growing.

The costs and some of the options in fault-tolerant systems have changed, but the basic functions haven't. Even small, micro-based systems ensure data integrity and continuation of operations when a processor fails. To do this, fault-tolerant systems incorporate redundancy in hardware, software, or both to provide instant backup. They also incorporate systems software to detect and locate failures and signal the backup element to take over.

Conventional computers like Digital Equipment Corp. VAXs and the new NCR 9800 from NCR Corp. (Dayton, OH) can guarantee about 96 percent availability in OLTP applications, says Marcia Brooks, an associate editor with International Data Corp., Framingham, MA, market researchers. Some systems provide a backup twin—a hot backup—of a primary processor, which pushes availability to 98 percent. But with fault-tolerant systems like those from Stratus and Tandem Computers Inc., the system is available all the time.

Tandem and Stratus are the largest fault-tolerant suppliers (the latter helped by an original equipment manufacturer agreement with IBM), and their separate designs represent the two major approaches to fault tolerance. In Tandem machines, independent processors, each with its own memory and input/output bus, communicate with each other over a pair of processor buses. The operating system constantly checks to see if both processors are working. If one fails, the opera-

Henry Hilliard

ting system can either direct the workload to the other processor or distribute it to a number of different processors. In Tandem's design, software manages linked but separate processors. During normal operation, each processor is working on different jobs; there is no need for the expense of redundant hardware. If one processor becomes overloaded, the system can clone additional modules to take over some of the load.

Tandem's architecture also allows for linear expandability. Doubling the number of processors doubles the capacity. Hardware-redundant architectures, on the other hand, normally require processors to share certain resources, such as memory. Adding additional processors may cause some degradation in the power of each processor under such systems.

The Achilles' heel of Tandem's design is the possibility that the workload shifted from a failed processor will reduce system performance, says Bill Elliott, Stratus' vice president of project development. If the other processors in the system are working to full capacity, he says, a shifted workload may degrade response time. Jerry Peterson, vice president in charge of international marketing at Tandem, says this scenario is rarely played out. Performance degradation, he asserts, is usually a symptom of inadequate capacity.

George Dinardo, executive vice president of the Pittsburgh Mellon Bank, which uses both Tandem and Stratus computers, agrees that some degradation can occur if a system is not configured right. "When we first got our Tandem a couple of years ago, we experienced some degradation because we hadn't purchased a system big enough to meet the demand of our busiest times," he recalls. "But now that the hardware costs are about half of what they were five years ago, we've upgraded our system and have no more problems with degradation."

Taken on balance, the risk of response degradation is a small issue, says Dinardo. At Pittsburgh Mellon Bank, a Tandem machine manages a service allowing large corporations to access certain files on the bank's three mainframes. The bank first used an IBM Series/1 mini as the front-end processor. "The Series/1 is fine if you are going to program it and put it in the closet," Dinardo says. "But we have found that the more you offer clients, the more they want, and we had to continually upgrade it to provide new services." That, along with the need to provide guaranteed access to customers, led Dinardo to consider Tandem and Stratus.

His group chose Tandem, which, although it was more difficult to program than the Stratus machine, was powerful enough to quickly route large numbers of transactions to the three different computers. "Our clients have large dp departments that are not afraid to write the more difficult code that Tandem requires," he says. "The Stratus option would have required a lot more component building to link the three computers and provide sophisticated applications."

The hardware-intensive fault-tolerant architecture is found in its purest form in Stratus systems. It includes redundant components—every part and all processes are duplicated. At every machine cycle—eight million times a second—each circuit board checks itself and compares the result with its clone. If a discrepancy occurs, the operating system determines which board has failed and deactivates it, continuing operations on the healthy board.

> "The cost of redundant hardware is already almost negligible."
> *Elliott, Stratus*

One of the most important advantages of the Stratus approach is that it eases application development. Programmers don't have to take fault-tolerant operations into account because, as they say, that's a hardware problem. This was an important consideration for the Boston Stock Exchange. Most of the applications for Beacon are being written by Ferncon Associates Inc., a Westford, MA, systems integrator. James Crofwell's in-house staff is learning the system and eventually will be responsible for maintaining it. Crofwell expects to save programming time and effort when they do. "Tandem and some of the other systems require special programming techniques that our staff is not prepared to handle," he says. "The Stratus XA 600 allows us to write code in Cobol or PL/1."

Ed Serotta, chief financial officer at Ferncon Associates, believes the programming issue was important enough to convince Tandem to offer programming utilities to its users. Tandem recently released a number of utilities to make "software checkpointing," the technique that builds fault tolerance into applications for Tandem systems, transparent to programmers. Tandem also offers an application generator with a menu format that guides programmers step by step through application development. George Dinardo asserts that Tandem's new utilities eliminate Stratus' previous programming edge. "We are finding that it takes no more time to program the Tandem than to program an IBM mainframe," he says.

The availability of off-the-shelf applications is probably one of the most important factors keeping Tandem and Stratus on top among fault-tolerant vendors. Analysts say that Tandem has the most packages written for it, with Stratus running second. Tandem's software lead comes from its being the grandfather of the industry. Stratus made a vigorous effort to encourage third-party developers to write software for its systems.

Speedy service is also becoming an important issue to users, says Omri Serlin, an OLTP consultant in Los Altos, CA. Vendors are offering better service options, such as remote online support and dispatch, automatic fault reporting and diagnosis, and user serviceability, he says. Most vendors operate support centers with software and hardware experts on staff, as well as extensive databases that hold records of the customers' past service reports. When a call comes in to a support center, the expert on call first tries to determine if the problem is a misunderstand-

ing or a result of an incorrect procedure. According to Serlin, IBM once reported that more than 60 percent of its customers' problems were solved during the initial call. If the problem requires a service call, many centers include service engineers who are automatically paged and sent to the site. The leader in support centers is IBM, but NCR, Concurrent Computer Corp. (Holmdel, NJ), and Tandem also have such centers.

Online support, in which the service center can diagnose and possibly repair the problem remotely, is more sophisticated than support centers. IBM, Tandem, and Concurrent all provide some online support. According to Serlin, however, Stratus has gone the furthest toward implementing online support. The Stratus support centers are connected to customer sites via a dialup network. Software to support the network resides partly at the customer sites and partly at the center. Often, problems are reported automatically by the hardware. Service center staffers can use the network to perform diagnostic tests, transmit files containing new versions of software fixes, or respond to electronic-mail requests. Customer personnel or Stratus field service engineers can also use the online system to diagnose problems and send reports.

Many users point to Stratus' service as an important reason for choosing that vendor's offerings. For example, the Pittsburgh Mellon Bank uses a Stratus XA400 Continuous Processing system to settle international currency transactions through its New York offices. The Stratus system functions as a communications bridge between the Clearing House Interbank Payment System and an international electronic funds transfer network. "Stratus' remote service is critical in our New York offices because we don't have the resources that are available to us here in Pittsburgh," Dinardo says. "In New York, we're a small fish, and we just can't demand the service that we do in Pittsburgh. When we have to choose between Stratus or Tandem for an application based in our headquarters, it's a difficult choice. But in New York, we use Stratus."

Although Tandem and Stratus are the leaders in fault-tolerant machines, other vendors are finding niches for themselves. Tolerant Systems offers the only fault-tolerant mainframe that is fully based on AT&T's Unix operating system. While at present Unix-compatible machines are a small portion of the fault-tolerant market —less than 5 percent, according to Canin —Tolerant is hoping it will become more significant as fault-tolerant machines are used for other applications, such as office automation.

Although Tolerant's system is closer to Stratus' redundant hardware architecture than to Tandem's software approach, it does offer significant differences. Tolerant distributes processing among several microprocessors in each central processing unit. One microprocessor handles real-time operating system tasks, another is dedicated to user applications, and another one or two handle inputs and outputs. As many as 12 other microprocessors outside the cpu are dedicated to communications. Processing is parallel rather than serial, which further speeds performance. When one processor fails, the transaction is automatically routed around the faulty processor.

The only other Unix-based fault-tolerant machine is Parallel Computers' 22/400XR series. Parallel is the only vendor that makes fault-tolerant machines in supermicro and minicomputer sizes. Basys Inc. (New York) uses Parallel computers in turnkey production systems for TV and radio newsrooms.

A number of vendors, notably NCR and DEC, offer machines with enhanced availability. The NCR 9800 series and the DEC VAXcluster do provide for some backup and recapture of files, but by being less than 100 percent fault tolerant, they are easier to program and less expensive than large fault-tolerant systems.

NCR's 9800 computers depart from past NCR design by using a modular, multiple processor-based incremental architecture that allows users to expand the system by adding "slices" of power. Under the architecture, the machine recovers from failure by switching files from one processor to another.

Most vendors of fault-tolerant machines predict that most OLTP systems will be fault tolerant by the end of the century. "The cost of redundant hardware is already almost negligible," says Bill Elliott of Stratus. "Eventually, it won't be effective for vendors to provide systems that aren't fault tolerant." Jeffrey Canin and other analysts agree that eventually fault-tolerant machines will dominate OLTP. In the meantime, vendors are finding that for certain applications, users are already demanding close to 100 percent availability. Competition is leading more installations to demand fault-tolerant machines from their vendors. □

Laurence Stevens is a free-lance writer based in Springfield, MA.

FAULT-TOLERANT OLTP COMPUTERS

Vendor/ machine	Notes	Price
Computer Consoles/Power 6/32 FT System (716) 482-5000	Fault-tolerant through hardware and software; 2 Mbytes to 8 Mbytes. Unix-based Perpos operating system	$600,000 Circle 493
Concurrent Computer/3200 Series (201) 758-7427	Fault-tolerant and OLTP-compatible through use of Resilient System and Reliance software. 1 Mbyte to 16 Mbytes. OS/32 operating system	$100,000 and up Circle 494
IBM/System/88 contact local sales office	Fault-tolerant through hardware, 4 Mbytes to 64 Mbytes. IBM S/88 operating system	$157,000 and up Circle 495
Parallel Computers/Parallel XR Series (408) 429-1338	Fault-tolerant through hardware, 4 Mbytes to 8 Mbytes. Unix operating system	$34,900 and up Circle 497
Sequoia Syst./Sequoia Series 100 (617) 480-0800	Fault-tolerant through hardware and software, 4 Mbytes to 2 Gbytes. Topix operating system has Sequoia kernel with Unix interface	$200,000 and up Circle 498
Stratus Computer/FT-250, XA 400, XA 600 (617) 460-2000	Fault-tolerant through hardware, 4 Mbytes to 64 Mbytes. Unix-based VOS operating system	$95,000 and up Circle 499
Tandem Computers/Nonstop Series (408) 725-6000	Fault-tolerant through hardware and software, 8 Mbytes to 256 Mbytes. Guardian operating system	$82,500 and up Circle 500
Tolerant Syst./Eternity Series (408) 946-5667	Fault-tolerant through hardware and software, 4 Mbytes to 12 Mbytes. Unix-based TX operating system	$215,000 and up Circle 501