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Building a Skilled State Information and Technology Workforce

By Charlene Wear Simmons, Ph.D. and Alicia Bugarin

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EXECUTIVE SUMMARY

California's state government has experienced several major computer debacles, including the collapse of the Department of Motor Vehicles' $51 million system; the failure the Statewide Automated Child Support System ($111 million in project costs and $90 million in federal penalties); and the cancellation of the Department of Corrections' Correctional Management Information System ($18 million). It is plausible that part of the explanation for these disasters lies in the state's personnel system. State government is unable to attract and keep enough highly skilled people with sophisticated skills in information technology (IT). State salaries are not competitive for these people, given the aggressive private sector demand for their talents. Training and advancement opportunities are insufficient. The state's personnel structure has responded only slowly to the rapidly changing technologies and skill requirements of modern computing. Many of the state's information technology staff and managers have backgrounds in personnel, administration, and fields other than computing – a practice thought inappropriate and quaint in the private sector.

Private companies with strong IT roles have struggled with this problem of attracting the right people to do complex work in a rapidly shifting technological field. So we interviewed top managers in several prominent corporations in California with strong IT roles, including companies that design and build computer hardware and software, and noncomputer companies that use IT in a very substantial way to carry out their businesses. Perhaps the most important observation from this survey is that private companies organize their IT people into "job families." People within a job family have related skills, and follow a more or less connected career path and salary ladder. Although they use different words, private sector IT job families all involve variations of these groupings:

- People who design, install, and maintain hardware.
- People who design, write, or adapt software
- People who run data bases.
- People who run networks and web sites.
- People who analyze business functions and figure out how computers can help
- Managers.

Private firms pay careful attention to salary levels in these categories, so they know what they need to pay to attract good employees. They encourage employees to keep up with the rapidly changing field by offering extensive training (employees who fail to keep up are "guided" to another career or out of the company), and they frequently review and sometimes revise their job categories. They contract for some services, but judiciously, since they mostly want to add to their own in-house skill base.

California's current civil service job classification system bears no particular resemblance to the private sector job categories. It relies instead on a few job categories that deal generally with computers, and another 30 or so categories that define niches,

each with only a few employees. It is as if there were tennis balls, golf balls, and basketballs in the world, and the state could not get beyond thinking it needed Recreational Services Spheroids. The catch-all categories offer no basis for thinking about the real skills needed to do the job, nor about how much an agency needs to pay to attract talented people. That this arrangement works at all is testament to the adaptive ingenuity of the state's bureaucracy, but it seems less than optimal. The Department of Personnel Administration is preparing a long overdue revision.

The state probably does not pay enough to attract many kinds of IT employees. Because of the mismatch between the state's job categories and those used in private industry, rigorous comparison is at least messy. The state does not systematically conduct exit interviews with IT employees (or any others) to find out why they are leaving. But anecdotal accounts of salaries and benefits of qualified web administrators and programmers abound, with private salaries sometimes doubling state levels. Private firms add annual or project bonuses and stock options, for which the state has no counterparts.

Private firms respond to the rapid change in IT technology with apparently well thought out and financed training programs to keep their employees up-to-speed. State agencies are less systematic, and less well funded. In addition, they are well aware of the possibility that well trained employees may be lured away by other state agencies, let alone private industry, and that they have no flexibility to offer salary or other benefits to retain those employees.

Some state IT managers are lateral transfers from state management positions in administration or personnel. That means they arrive without technical training or experience in IT functions. The apparent theory is that IT management is largely a "people skill" function. This notion made no sense to any of the private firms that we interviewed, who regard technical background as essential for IT management. Of course, attracting technically skilled IT managers to state service might require paying considerably higher salary levels than are current, but might also pay dividends and help avoid debacles.

Private firms recognize that recruiting new IT talent is difficult and expensive, and they work hard at it. They recruit through college placement services, use the Internet extensively, and make heavy use of professional head-hunters. The state has made only quite modest efforts along these lines.

The report concludes with several options for improving California state government's IT personnel system.

INTRODUCTION

Technology is reshaping and challenging businesses and governments worldwide, requiring agile and flexible responses. The key issue is how organizations can best generate and use the information they need to stimulate innovation and promote productivity. Information proficiency—"the effective use of information to define and achieve goals"[1]—is the ultimate goal of any productive use of technology.

Skilled and committed people are an organization's most important resource. They determine organizational goals and implement information technology initiatives. Building, maintaining and marshaling the human capital needed to achieve results is critical. Thus recruiting, hiring, training and retaining skilled people with technical expertise and business knowledge is essential to effective and successful organizational performance. For the state, the key issue is how to achieve and maintain a level of skills and expertise that enables it to solve current and future problems.

State government is a very complex business enterprise. It is increasingly dependent on effective information technology (IT) systems to implement and deliver services and to operate business processes, at an annual cost of $1.5 to $2 billion. "Reinventing government" by improving productivity is highly dependent on automating work processes, thereby freeing up employees to concentrate on critical activities.

Bill Gates contends in a recent interview in *Fortune* magazine that "Because government is so information-intensive, the opportunity to do better is more dramatic there than in the corporate case."[2] Major new policy initiatives, such as welfare reform, require integrated efforts that involve multiple agencies, federal-state-local partnerships, and public-private alliances. As a practical matter, they require exchanging and cross tabulating data between complex IT systems administered by different agencies. However the state's IT project track record is uneven. Over the last several years the state has experienced several large project failures, notably at the Departments of Motor Vehicles and Social Services.

This report examines the question, "Does state government have a significant [information technology] recruitment and retention problem, and if so, [what are] its causes and possible remedies."[3] The short answer to the first question is "yes," particularly in securing and retaining employees with the skills required for new and

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emerging technologies, such as the Internet and internal networking systems. This is perhaps not surprising, given headlines about the "Great IT Labor Shortage"[4] that report a hot labor market in which skilled IT workers are in great demand. As one example of this phenomenon, the *Washington Post* has launched a separate, 26-page Technology Employment classified-ad Sunday section. Companies have responded with hefty wage increases and enhanced benefits over the last several years. In contrast, state employees received their first raise in more than four years (5.5 percent) effective April 1, 1999; the cost of living increased more than ten percent during that period of time. Salaries are only one aspect of the problem, however.

Research presented in this report indicates that the state's information technology staffing problem, and its causes and possible remedies, is complex and encompasses a number of personnel and business practices. Achieving a full understanding of the problem is important in order to craft a range of solutions.

State information technology (IT) managers definitely feel that there is a problem. A recent survey of 25 state departments found that:[5]

- Nine out of ten departments agree that the current civil service job classification structure inhibits their ability to hire and retain qualified IT staff.
- More than one out of five jobs in key IT skill areas is vacant (in application programming, information technology management, network administration and telecommunications), requiring an average of more than three months to fill.
- Over half of the departments report that there is inadequate communication between their personnel and IT shops to support the recruitment of qualified candidates.
- Nearly two-thirds of the departments state that they are not successful at matching IT candidates with the job requirements.
- In three-quarters of the departments performance expectations are not consistently set for IT employees.
- A small but significant number (around six percent) of some key IT positions—managers, applications specialists, client technical support and network administrators—are viewed as underqualified.

Interviews with key state departmental Chief Information Officers (CIOs) suggest a more severe problem. One is of the opinion that half of the state's IT workforce is under-qualified due to pressure to fill or lose positions and lack of training. Another problem results from the state's 24-year-old IT civil service classifications, which establish minimum qualifications for hiring purposes. They predate widespread use of the personal computer and are severely out-of-date (for example, requiring mainframe and older software skills). They have been a hindrance to recruiting people with new skills.[*] Meanwhile, the IT field is changing rapidly along with the evolution of technology.

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[*] The Department of Personnel Administration is revising the state's IT job groups (or classes) with the goal of updating them as soon as July 1999.

The State is not alone in confronting an IT staffing problem. Other state governments and California companies, small and large, in technology and other businesses, are also experiencing challenges in keeping and finding skilled IT workers. In testimony before the U.S. Senate, a Microsoft Vice President noted that:

> …the fundamental shift in our economy away from service industries
> toward information industries will profoundly increase the demands for
> individuals with technical skills and knowledge. Businesses not previously
> considered part of the IT industry, such as banks, insurance companies,
> media conglomerates and even Mom & Pop retail stores selling t-shirts
> on the Internet, will require employees who have the technical skills
> necessary to succeed in the digital economy.[6]

A 1997 study by Virginia Tech for the Information Technology Association of America estimated that one in ten IT positions in the U.S. economy was unfilled due to an "exploding demand" for skilled engineers and computer scientists. Although some of the study's conclusions have been contested,[7] it seems clear that there is a strong demand for individuals with IT skills, particularly in certain "cutting edge" technologies that underlie the Internet and electronic commerce and internal operations networking between data systems.[8]

Pressure to hire technology workers began to build sharply as the U.S. economy boomed in 1996-1997, leading to rising wages in high-demand IT occupations: the average IT salary increase that year was 11 percent.[9] Increases in base IT pay averaged between three and five percent in 1995-1996 and 1997-1998—a combined three-year average increase of about 20 percent. Companies also enhanced their bonus programs and noncash incentives.[10]

California state government operates in an extremely competitive information technology labor market and competes with the private sector for its workers. The state's major population centers in Los Angeles, San Diego, and the San Francisco Bay Area are important centers of high technology industry. The job market in Silicon Valley—the "No. 1 high-technology spot on the planet"[11]—has been booming. Sacramento, at one time a comfortable "company town" for state government, is now part of the I-80 high technology corridor. State government cannot take its Sacramento employment base for granted.[†] Companies are targeting state agencies as a potential source for their workers, and state agencies are raiding each other's skilled employees.[‡]

[†] The American Electronics Association defines the Northern California high-technology industry as being located in "…San Jose, San Francisco, Sacramento, and Oakland…" *California Cybercities*, 1998, p. 8.
[‡] Approximately 17 percent of the state information technology position vacancies in FY 1997-1998 were created when incumbents left to work in other agencies. (See Task Force on Information Technology Staff Recruitment and Retention, *Protecting and Improving the Delivery of Services to California*, October 1998.)

Retaining skilled IT workers is an important challenge. A national study found that IT workers are almost twice as likely to leave their jobs as the average employee, and they are expensive to replace.[12] The same study identified signs that can warn companies that their most marketable people are considering leaving. They include poor evaluations of managers, calls from outside employee recruiters, the raising of compensation issues, employee perceptions of having reached a plateau or a transition point, the departure of a respected mentor, and restructuring or downsizing. The benefits offered by state civil service are not as highly valued by IT workers, who tend to value personal growth and the ability to contribute more than loyalty and job security. They also generally prefer to work in informal, team-based work environments, not the hierarchical command and control structures that characterize some state agencies.

As information technology reshapes business organizations, these same technologies challenge government management styles, policymaking and service delivery. Increasingly citizens expect quick and accurate transactions and ease of access to information. "Government departments and agencies, whether they realize it, are today in competition with the commercial world, at least in organizational operation."[13]

HOW CALIFORNIA BUSINESSES MANAGE WORKFORCE ISSUES

Technology has moved from being provided as a peripheral service to a central business asset that is critical for business success, particularly for productivity and innovation. Businesses are learning that they must evolve their organizations quickly in order to remain competitive. John Chambers, CEO of Cisco Systems, notes that technology changes in "dog years"—seven years of development are packed into one calendar year. The *Wall Street* reports that, "Companies that use technology wisely are finding that they work faster, cheaper and more efficiently." [14]   In this environment, corporate values stress flexibility, agility, responsiveness, learning and continuous improvement.

California businesses place a high priority on making sure that they have the right mix of people with critical technology skills to successfully run their organizations: "Only when the right employees are on board and provided with the training, tools, structure, incentives, and accountability to work effectively is organizational success possible."[15] Employees with highly valued skills are in demand, a dynamic process that evolves with the technology. Companies are challenged to recruit, train and retain the skilled technology workers that they need to compete. At the same time, workers must engage in a continuous learning process to update and maintain their skills

IT Case Studies

Recruitment and retention of skilled IT employees are major corporate priorities. In order to understand corporate practices, we interviewed top executives at a number of key California companies.[§]   They graciously shared information about their IT operations in a number of areas: job skills, salary, recruitment, training and retention. Some of the information was fairly general, given its proprietary nature. Several of these companies are in the IT business and others, such as the Bank of America, are not. In all cases, IT functions are critical to their operations and are the focus of considerable high level attention. Our goal is to present a general model of corporate IT employment practices.

Job Families

Our first questions examine how companies conceive of and organize their workforces in order to ensure that they have the IT skills they require to meet their business needs. In general, the California companies that we interviewed organize their work by broadly functional skills categories or "job families." These job families serve as a means to organize compensation, group skills sets and define career paths. They are also the basis for measuring and adjusting competitive salaries, using surveys, and for recruiting job candidates.

[§] Our thanks to the corporate executives who serve on the Department of Information Technology's Council for their time and assistance: Gerald Corvino, Zilog Corporation; Robert Payne, IBM; Chuck Dietrich, Microsoft; Michaele Rittenberg, Sun Microsystems; Thomas Buckholtz, Charlton Innovations; and Peter Meule, Bank of America.

Some information technology (IT) skills are fairly basic. Most businesses do not experience problems when filling basic skill positions, such as data entry, for example. Routine work can be automated.

Within IT "job families," employees progress through stages defined by core competencies that require increased skills and responsibilities. As their performance level increases, IT employees ascend a broad salary band. Many companies also provide for considerable movement between broad job categories. Similarly, managers achieve increased levels of responsibility and compensation as their skills and performance warrant.

In general, the following generic job families define most IT work:

- *Operations/Systems administration*—hardware installation and maintenance, systems installation and testing, Help (problem resolution);

- *Database administration*—design, testing, troubleshooting;

- *Software applications*—designs, defines, tests for internal applications;

- *Network/web*—Internet and intranet design, configuration, troubleshooting;

- *Business analysis*—analyze client technical/business needs, create strategic plans, define functional specifications; and

- *Supervisor/management—*project, program and staff supervision and management.

The following table compares these general job families, developed for this report, with the corporate job families described by interviewed corporate executives. There is considerable congruence, particularly for corporate operations (Sun and Zilog). Some functions are not part of regional operations (IBM, Microsoft), while Bank of America's job classifications are very broad. A large enterprise like the State of California requires individuals working in each of these functional areas.

Table 1 CRB Survey of Corporate IT Job Families				
General Description of Job Family	Sun (corporate)	Zilog (corporate)	IBM (regional)*	Microsoft (regional)*
Operations/Systems Administration	System Technologies	Other Infrastructure		Systems Engineer/Technician
Database Administration	Database Technologist	Data management		
Software Applications	Software Systems Engineer	Applications	Programmers and Testers	Software Engineer
Network/Web	Networking Technologist	Network		
Business Analysts	Business Technologist	Project Management	Project and Policy Managers	Product Manager
Supervisor/Manager	Staff and Project Management			Program Manager
Data derived from interviews *Does not include full spectrum of corporate job families, regional office only.				

Each job family defines an industry-wide recognized career path, salary levels and the skills required for entry and promotion. Corporations devote considerable time to ensuring that their operations and job families are well organized to support the flow of work. In a recent example, a hotel and resort company restructured its IT operations into an operations group, a networking development group, and an application development group, along with an improved help desk response.[16]

IT skills can quickly become obsolete while new skills gain a high value. Thus it requires considerable time and attention to maintain an effective skills-based personnel system for IT. All of the interviewed companies devote significant management time to updating and fine-tuning their IT personnel systems. Job categories change as technology evolves. For example, "webmasters" did not exist four years ago.

SUN Microsystems, a well-known California technology company, organizes its "information resources" skills into job families that fall into three broad categories:

- Systems administration
- Programmer, developer, support
- Business analyst, project management

SUN management conceives of its workers as operating in a fluid skills market, moving in and out of different job categories within the company. Even with this flexibility, the company is currently reorganizing its IT job families, which are four years old (Table 2).

	Table 2	
SUN Microsystems Information Resource (IR) Job Families		
Job Family	**Basic Function**	**Major Duties**
IR System Technologies	Implement & maintain system	Systems installation, testing and trouble-shooting Systems network, gateway, database administration End-user training, problem resolution
IR Database Technologist	Develop & maintain databases	Database design, testing, support Database standards, procedures, parameters Preventive maintenance, troubleshooting
IR Networking Technologist	Network maintenance & repair	Network configuration Network troubleshooting, failure analysis Test of new releases
IR Software Systems Engineer	Software development	Definition & specification of software requirements Design, develop, test internal apps. software Debug errors
IR Business Technologist	Business/tech. Consultant to clients	Analyze client group's technical/business needs Define functional/technical specifications Create strategic plans for complex business requirements
IR Web Technologist	Development & support for SunWeb	Design/develop technology for SunWeb SunWeb tech support and maintenance SunWeb standards, integrity and performance
IR Supervisor/ Manager	Staff & project management	Human Resource Management Responsibility for financial & staff resources Ownership of critical IR strategic projects

Management positions at SUN require negotiation and project management skills, and involve budgeting and planning at the highest levels. However most SUN managers also have technical backgrounds: "The financial folks need to understand the context for the whole system in order to understand what you can afford to lose." When asked whether personnel management skills translate well into the technical side, SUN's Vice President of Enterprise Management and Architecture strongly suggested that they do not. The reason is that pulling together large systems is a technically complex operation and it helps if the manager has a technical background. (In contrast, some state IT managers have "moved over" to IT management via lateral transfers from personnel, as discussed later in the report.)

Zilog Corporation is a medium-sized California company. It tries to keep its organizational structure as flat as possible, in contrast to larger organizations that often create separate departments for various functions. The following key company job categories require project management skills. Employees are also responsible for developing and maintaining company-wide system standards and architecture.

Table 3	
Zilog Corporation – Key IT Job Categories	
Key Job Categories	**Key Functions**
Network	Web and distributed computing (data and voice networking).
Other Infrastructure	Desktop support (HELP), data systems, classical operations such as UNIX, NT support.
Applications	Software acquisition and integration
Data Management	Information access and architecture strategies and planning on how to integrate data into the organization.
Project Management	Provide centralized management.

On the question as to whether personnel management skills are applicable in the IT arena, Zilog's CIO says that the company has moved personnel specialists into its "applications" jobs. However he would not recommend moving them into infrastructure or networking positions.

Zilog has established a common company backbone of IT infrastructure standards that are built into its systems. This "architecture" underlies all new projects, including system modernization efforts. (In contrast, Zilog's CIO notes that the State of California has not established a common, standard IT operations infrastructure or "architecture." Each project specifies its own standards, leading to costly and incompatible projects.)

The Bank of America has created IT "job families" with half a dozen different pay lines, depending on an individual's degree of technical knowledge, independence, impact, and amount of peer interaction. The goal is to pay individuals by performance, according to their contribution to the company. There is no separate salary structure for IT, as the separate pay lines are generally flexible enough to allow the company to bring in skilled employees. Key job families in the bank's line operations include:

- *Clerical*—Clerical roles are task-oriented and paid by the hour. Many data entry level positions have been replaced by scanning, but the company still needs some word processing skills. At the time of the interview (October 1998), the company was having trouble finding qualified data entry processors and was about 20 percent off its hiring goals.
- *Non-management*—The bank has four grade levels of non-management positions.
- *Professional*—The bank has five levels within the professional or management ranks. It is currently using professional hires to bring in new and needed skills in hard-to-find technology areas such as telecommunications, networking, NT and interactive banking.

The Bank of America operates four large data centers in which IT is treated as a utility—an essential input. The company's core data processing is centralized in the

data centers, not in the bank's line departments. This is to ensure a stable, secure environment in which the customer database is protected. The Concord and Seattle technology campuses employ about 3,500 software program developers and 2,500 people in operations and technology (hardware and systems software). The bank also has an IT systems engineering group.

IBM Global Services, *California State Government*, is a regional operation with a more restricted set of functions than the corporation as a whole. The regional management determines which IT skills are "core" to its business. In general, the company pursues and retains individuals with critical core skills and contracts out for others. The reason is that it is difficult and expensive to recruit and retain workers in every IT skills area. The following general job categories describe the core skills required by this regional operation:

- Programmers
- Testers (software)—create unique methodologies such as positive and negative testing, regression testing, configuration management and change control.
- Project managers—require a mix of risk management, financial background, and customer understanding. Project managers usually have IT backgrounds, but sometimes come from the business side of the company's operations.
- Policy managers or business experts—understand the customer's operations and needs, and work with state and federal regulators on government projects.

IBM considers project management to be a critical, core skill. The company prefers to hire "entrepreneurs," viewing each project as a small business with its own requirements for a positive profit/loss balance and customer satisfaction. When hiring project managers, the company looks for past successful projects and evidence of an individual's flexibility to deliver the appropriate product to meet a customer's needs. Flexibility is important as IT projects may need to evolve beyond the original contract specifications in order to be successful. (In contrast, the state is at a particular disadvantage when agencies create inflexible contracts, as is a common practice.) It is difficult to find one person who has both IT project management skills and an understanding of the customer's policy/business needs. The solution is a dual management team—a project manager and a policy manager.

In the opinion of this senior IBM executive, personnel managers do not make good IT project managers. They are "too nice," often trained in consensus management which does not work in this context--what is needed is a "benevolent dictator."

Microsoft is a worldwide technology business. Its regional IT business operations encompass:

- Project management of a world wide company network (including a communications and hardware and software infrastructure); and

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- Development and analysis of business applications to enhance company productivity.

Bill Gates states that Microsoft tries, "to keep the number of organization levels down and the lines of communication open."[17] The company organizes its IT business operations jobs into four categories.

- Software Engineer (entry and senior)
- Program Manager
- Product Manager—internal marketing
- Systems Engineer/Technician (specialists)

Product managers function as technical liaisons between the business people and developers responsible for detailed program specifications. They are "deep technicians with management skills" who also understand business requirements. The California Microsoft executive interviewed for this report asserts that personnel managers do not make good IT managers; in fact the reverse is true at Microsoft—IT runs HR (Human Resources).

Compensation: Salaries, Bonuses, Retirement Benefits

Salaries

IT managers rank "competitive compensation" as the most important criteria for assessing employee satisfaction.[18] Corporate reward systems express organizational priorities, affect recruitment and influence employee loyalty and performance.

State government competes for IT employees in some of the most competitive high-tech markets in the world. Sacramento is the state's fastest-growing "cybercity;" according to a recent survey by the American Electronic Association, Sacramento experienced a 56 percent high-tech job growth from 1990 to 1996 (from 19,000 to 30,000).[19] The Center for the Continuing Study of the California Economy reports that the San Francisco Bay Area is the state's wealthiest region, with a 1997 per capita income that is approximately 30 percent higher than the state or national average. The Sacramento region, "led by per capita income gains related to high-tech growth, moved up to second place among (California) regions in 1997."[20] The Center projects that total California personal income, adjusted for inflation, will increase by 3.4 percent per year over the next five years.[21]

Computer services was California's fastest growing high wage sector in 1995, 1996 and 1997; the average wage is now over $60,000 a year.[22] The average 1996 high-tech annual wage in Sacramento was $50,705; $71,859 in San Jose; $65,876 in San Francisco; and $51,388 in Los Angeles.[23] In comparison, the general private sector annual average wage in California was $31,200 in 1996.[24]

Salaries for the people with technology skills in demand have skyrocketed in the last three years. According to *Computerworld's* 1997 annual skills survey, eleven of 26 information systems positions had received average salary increases of ten percent or more the previous year, while only five received less than five percent. Systems analysts got the biggest raises, while Webmasters and managers of Internet/intranet technology commanded the highest salary premiums (23-40 percent). [25] The Chair of UC Berkeley's Department of Electrical Engineering reported that, "Starting salaries for Berkeley BSCS degree-holders averaged $47,000 last spring [1997], 17.5 percent higher than in 1995."[26]

Table 4 **Information Services Compensation** (a three-year comparison)					
Job Title	**1995**	**1996**	**1997**	**'95-'96% increase**	**'96-'97% increase**
CIO/VP of IS/IT	$91,600	$96,400	$123,100	5%	28%
Systems Analyst/Admin.	$45,400	$44,500	$51,000	-2%	15%
Programmer/Analyst	$37,200	$38,800	$43,000	4%	11%
Director of Systems Development	$73,000	$74,400	$82,200	2%	10%
Computer Operator/Data Processing Manager	$49,500	$50,600	$55,500	2%	10%
Senior Systems Programmer	$51,700	$51,700	$56,500	0%	9%
Source*: Computerworld,* August 1997					

A more recent *Computerworld* survey (1998) found that IT salary growth had slowed down over the previous year, averaging between three and five percent, but with an increasing emphasis on year-end performance bonuses, project incentives, stock options, signing and retention bonuses and nonmonetary performance awards.[27] Similar average salary growth is projected for 1999. However, salary surveys that report *average* increases obscure the soaring compensation for specialized, new IT skills. For example, Zilog's CIO states that the salary escalation for webmasters is "beyond belief," averaging 15-20 percent this year.

Very recent data developed by *InformationWeek* shows IT salary increases of approximately six to twelve percent in the last year. New job titles have evolved since *Computerworld's* earlier survey, but in general the functions fit within the six general functional job categories described in Table 1 (page 7).

Chart 1

HOT MANAGEMENT AREAS
How Large a Raise in Annual Base Salary Did You Get This Year?

Category	
Help desk, IT support	
Internet	
Enterprise resource planning	
Data mining, data warehousing	
Year 2000	
Database analysis and development	
General IT management	
Security	
Networking	
Data center management	
Application development	
Telecommunications, call center	

% Increase in Base Salary
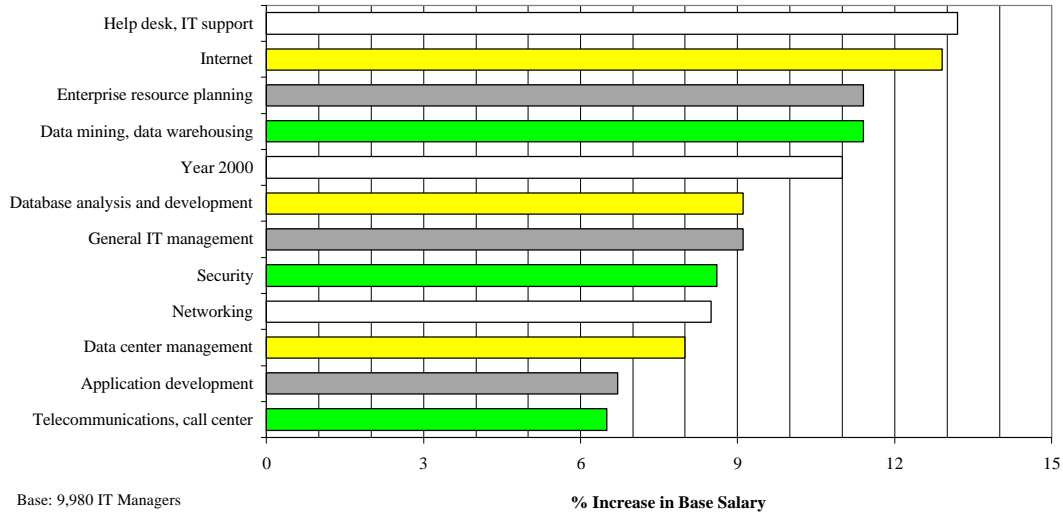
Base: 9,980 IT Managers
Data: *InformationWeek* Research Salary Survey of 21,398 IT Professionals
Source: *InformationWeek,* April 26, 1999, p. 47

Chart 2
HOT STAFF AREAS
How Large a Raise in Annual Base Salary Did You Get This Year?
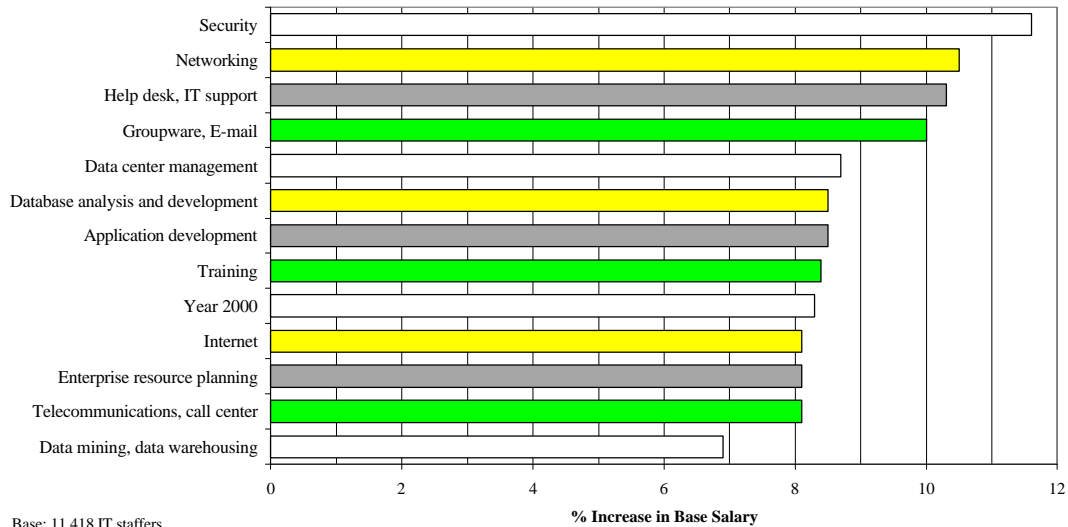
Category	
Security	
Networking	
Help desk, IT support	
Groupware, E-mail	
Data center management	
Database analysis and development	
Application development	
Training	
Year 2000	
Internet	
Enterprise resource planning	
Telecommunications, call center	
Data mining, data warehousing	

% Increase in Base Salary

Base: 11,418 IT staffers
Data: *InformationWeek* Research Salary Survey of 21,398 IT Professionals
Source: *InformationWeek,* April 26, 1999, p. 48

An individual's market value (salary) fluctuates with the rapidly changing demand for specific IT skills. For example, salaries are expected to rise 16.3 percent for database administrators and 18.4 percent for specialized applications programmers (C, C++, Visual Basic) in 1999.[28] A 1998 survey by the American Electronic Association found that jobs in the Internet industry currently command premium salaries; the vast majority are above $50,000. Internet strategists, responsible for executive overall corporate Web strategies, average $115,000, and electronic commerce managers top out at $133,000 a year. According to the Director of Human Resources at Netscape Communication Corp., "…the company must wage constant war with competitors, headhunters and venture capital-backed start-ups for its best and brightest workers…. We are having to do a salary survey twice a year; and in some categories, we'll do one every quarter." Pay raises at Netscape in 1998 ranged from five percent at the low end to 20 percent for those at greatest risk of being recruited.[29]

Chart 3
ENTERPRISE RESOURCE PLANNING STAFF MAKES THE MOST
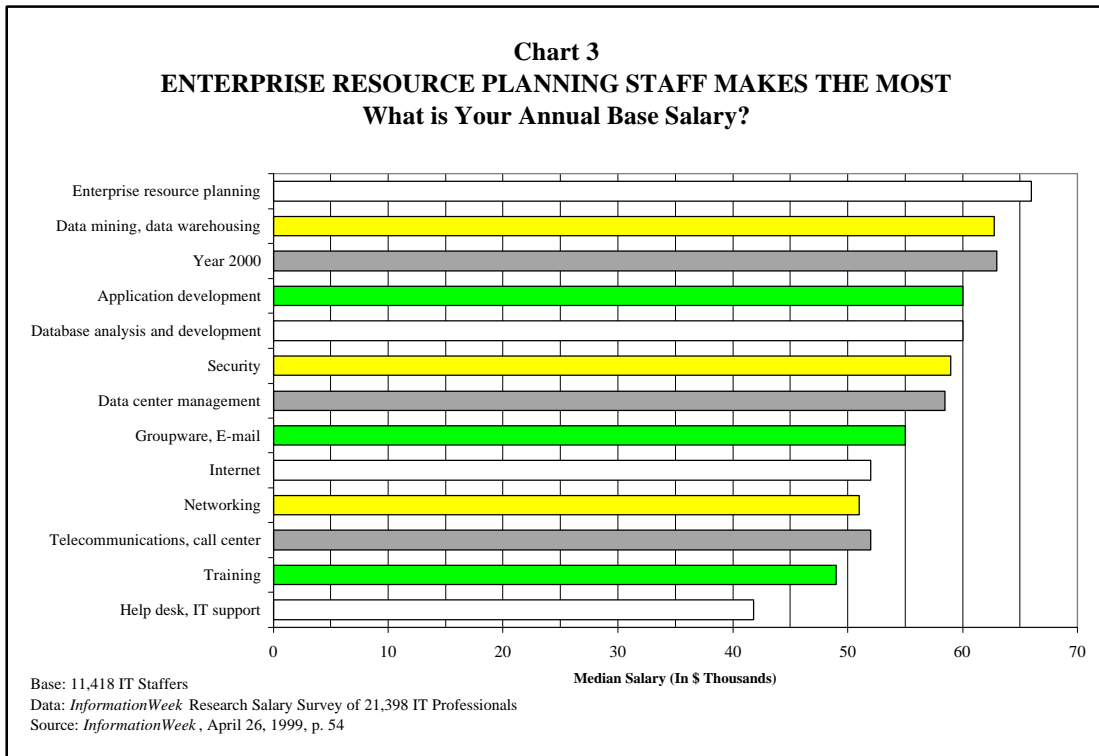**What is Your Annual Base Salary?**

Base: 11,418 IT Staffers
Data: *InformationWeek* Research Salary Survey of 21,398 IT Professionals
Source: *InformationWeek*, April 26, 1999, p. 54

The following diagram, adapted from *Fortune*, illustrates the evolving importance of networks, which is likely to create a sustained demand for individuals with networking technology skills: "Self-contained mainframes, servers, and PCs will give way to specialized computers and other smart gadgets that cooperate and share information…the network will be what's important: a meta-world in which much of our business activity and communication and daily routines take place."[30]
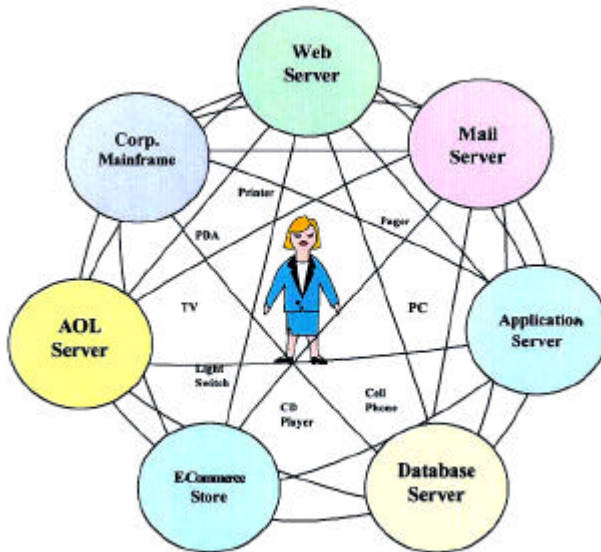
Source: *Fortune*, February 15, 1999, p. 87.

The California companies we interviewed did not share detailed proprietary salary information, but rather general guidelines. Several stated that it is too difficult and expensive to attract and retain every IT skill. They rely on contractors for short term, non-core operational IT needs in highly specialized areas.

- *Bank of America* has half a dozen different pay lines for its IT and bank operations, depending on an individual's degree of technical knowledge, independence, impact and peer interface. The Bank also has separate pay lines to help bring in skilled IT employees.

- *Sun* administers its salary guidelines by levels. The company looks at its recruitment and retention statistics and conducts market studies for competitiveness. Sun's general guideline is to compensate at 75 percent of the market's highest level.

- *Zilog's* CIO says that escalating salaries are an issue, particularly for skills such as NT Windows and Web networking (a 15-20 percent increase in one year). In general the company works off a standard salary series which is updated yearly. As the year progresses, the company makes incremental adjustments to remain competitive. The policy in some job categories is to offer better than midpoint in the salary range.

- *IBM* assesses critical skills that are difficult to obtain in the marketplace and gives them significantly higher pay increases (11-12 percent versus five percent). Last year those skill categories included project management, IT architects, and policy managers. This year programmers and testers will probably also be included. A good IBM project manager makes between $100,000 and $150,000 a year (salary plus up to a 30 percent bonus). Salary and professional responsibilities increase relative to a manager's annual project business. For example, a beginning project

manager in Sacramento might manage $1-2 million in business and earn $80,000 a year.

- *Microsoft* prefers to bring in its IT employees at 50 percent of the market salary range, but goes up to 75 percent and higher, depending on the skill. There are salary ranges within job levels. The company offers highly valued stock options as part of its compensation package.[**]

Salary is not the most important motivation for most employees. Research indicates that IT professionals highly value a good workplace and the opportunity to work on a variety of meaningful projects that offer personal growth. However at a certain point, disparities between an individual's salary and salary opportunities in other organizations become compelling. Employees in poorly managed organizations with high turnover are likely to change jobs for a pay increase of 10-15 percent. In contrast, employees in well-managed IT organizations with low turnover are not likely to leave for less than a 20-30 percent pay increase.[31]

According to *Computerworld*, there was a 16 percent turnover of computer software/hardware employees in 1996.[32] More recently, the Information Technology Association of America reports that "Many companies are reporting annual turnover percentages in the high teens to the low 20s."[33]

Performance Awards

Performance awards for individuals working in IT, bonuses for successfully completing a project, and training annuities are common business practices. Companies are also using retention bonuses, generally ranging from 15 to 30 percent of salary over a three year period, to retain valued IT employees, such as to complete Y2K projects. According to a 1998 survey, "…approximately half of engineering/high-tech…executives will receive bonuses, averaging some 10-18 percent of their base salaries"; an estimated seven to eight percent of engineering managers will earn bonuses averaging seven percent of their base salaries; and five percent of engineering/high-tech professionals will earn bonuses average five to six percent.[34]

Table 5 Criteria for Performance Bonuses	
	% of total compensation
Individual job performance	5 %
Department performance	1%
Company financial performance	5%
Source: *Computerworld*, August 1997	

[**] Recent news articles indicate that Microsoft has expanded job categories and increased pay ranges in order to remain competitive with faster growing technology companies that offer more valuable stock options.

Bonuses are a way to reward people without throwing a company's salary structure out of alignment. Big companies are more likely than small companies to give bonuses, based on company and/or individual performance. Rewards that highlight certain behaviors and skills give a message to employees as to what an organization values. People adjust their effort in part in relation to the monetary return they expect.

Our corporate interviews indicate that bonuses are part of the private sector IT culture. IT professionals expect to receive bonuses as part of their performance-based compensation packages.[††]

- *Bank of America* offers merit-based compensation including promotions and raises, year-end and spot bonuses, and stock options at all levels. "Exceptional performance awards" are targeted to the top 20 percent of performers as identified by managers, and range from five percent of compensation down to $200 and recognition.

- *Sun* offers different levels of bonuses for performance, including a yearly management bonus based on company performance. The company also offers profit sharing as a motivator. The company does not pay overtime, but has a "paying for performance culture," with accountability for deliverables on time and in budget.

- *Zilog* offers stock options, individual and team bonuses for project completion within the time frame, and bonuses to retain people with critical skills (in both the business and technical areas).

- *IBM* evaluates its project managers according to customer satisfaction, profitability and the quality of their deliverables, and rewards them with career promotions and bonuses.

- *Microsoft* offers stock options and bonuses of up to 15 percent of salary. The company also pays above base pay, dependent on achieving a sales quota.

- "*Sears* has an annual incentive plan based on a mixture of overall company success and the success of the particular business units an IS person supports…these factors account for 11% of compensation. An additional 1% is pegged to individual performance goals."[35]

Retirement plans are also part of an organization's compensation system in a competitive labor market. State government employment has historically been attractive for its

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[††] In contrast, one interviewee notes that the state does not offer incentives to its IT managers nor reward successful projects. State contracts generally do not specify criteria for success, by which managers could be recognized. In fact, the incentives are for state managers to be cautious, which often results in slipped deadlines.

security, benefits and stability. However that advantage is lessened in today's favorable IT job market. According to a 1997 survey by William M. Mercer Investment Consulting Inc., 70 percent of employers had made changes to their retirement systems in the past two years, and nearly half had plans to make further changes. Adding or increasing of investment options was the most common change.[36]

Recruitment

The boom in IT recruitment is due in part to the healthy state of the U.S. economy, the rapid pace of innovation, the competitive application of new technologies (such as e-commerce), the Y2K challenge, and a relatively limited pool of qualified applicants. The companies we interviewed all regard recruitment of qualified IT workers as a high priority and devote significant resources to it. They use a variety of mechanisms such as job fairs, employee referrals and the Internet to aggressively seek qualified candidates.

At the national level, there is considerable dispute about the size of the potential IT applicant pool and the range of skill sets that might meet business needs (for example, computer science degrees only[37]). There is also some evidence of distortions in the job market caused by age and other types of discrimination.[‡‡] Nonetheless, California companies that share state government's IT employment market act as if there is a shortage of qualified workers, and salary inflation suggests a competitive, skills-sellers' market. Job turnover in Silicon Valley averages about 15 percent, and company managers are "focused on recruiting as never before."[38]

Some IT skills are particularly scarce. Currently, the most difficult-to-find skills are Oracle, COBOL, UNIX, Networking (Internet and intranets) and Windows NT server.[39] This list changes over time along with the evolution of technology and its application to competitive business practices. Employees and companies must scramble to keep up.

Bank of America actively recruits at job fairs, follows up on personal referrals by current employees, and uses professional recruiters for management level recruitment. The company also recruits from its pool of temporary contract employees and conducts minority outreach efforts. Recent college graduates are targeted for entry programming levels. The interview process includes a programming aptitude test and rigorous interviews conducted by a person from personnel and two to three line managers. The company uses professional recruitment firms to bring in new IT skills, particularly in hard-to-find areas such as skilled telecommunications, networking, NT, and interactive banking.

Sun operates in a fluid skills market and utilizes a variety of methods to recruit job candidates, including newspapers, technology fairs and college interviews. Company recruiters speak at college campuses and can offer jobs on-the-spot, as many vendors are

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[‡‡] "…there seems to be a paradoxical view of IT workers over 40. On the one hand…older workers are more disciplined and well-versed in the technologies most in demand in their organizations today. But on the flip side, perceptions that older workers lack the hot skills that soon will be in great demand—and are more costly, less motivated and less flexible—work against them." Barb Cole-Gomolski, "Pay, hot tech block IT vets," *ComputerWorld*, December 1, 1998.

doing. Competitive job fairs such as Westech require companies to reach quick decisions and make prompt job offers. At Sun, successful on-the-spot hiring requires a well designed job description, budget pre-approval, two to three people to conduct the interview, and a person from personnel to make the offer.

People come to work for Sun at different skills levels. The company relies heavily on outside hires for mid-range positions, for example. At the time of the interview, Sun was experiencing difficulties in recruiting programmers and systems operators, and finding it difficult to recruit and retain workers skilled in applications such as UNIX, Oracle, and SAP.

Zilog's CIO calls recruiting "a huge problem," especially for individuals skilled in systems administration (e.g. Windows NT), relational and applications data bases (Oracle, Informix, SAP), and for data network engineers. Zilog recruits at job fairs and colleges and on the Web. The company uses private recruiters, but they are expensive (up to 30 percent of the first year salary).

In the opinion of Zilog's CIO, print ads do not work as a recruitment tool for IT employees and the Internet is the best recruitment medium. Recent articles support his viewpoint. For example, Texas Instruments obtained about ten percent of its engineering hires from Internet contacts in 1997, up from two percent in 1995.[40] According to *Fortune* magazine,

> The Web has become the essential place to look for top-paying positions, particularly in technology, finance and accounting, and sales and marketing. Fast-growing Web services such as Monster Board, CareerBuilder, Online Career Center (OCC), and Jobtrak are catering both to seasoned professionals and to new graduates, especially in engineering and computer sciences. Web recruitment sites are free to the searcher, and the employer typically pays $2,000 to $2,500 a month to advertise as many as 100 job openings. For this relatively small fee, they can receive thousands of resumes.…[41]

A number of companies and cities have created their own websites for IT recruitment purposes. For example, the city of Richardson, Texas, home to "the Telecom Corridor," features jobs at all 129 Technology Business Council member companies on its website, www.ejobs.com/. (In contrast, each California state department advertises its jobs separately, largely by print notices. The State Personnel Board has a few entry level exams on its website, but the searcher must know to look on its website.) Some businesses advertise their job openings over the radio.

Microsoft recruits for specific needs and for "raw technical talent," bright people with a generalized set of skills that can meet a variety of company needs. A dedicated recruiting group focuses on external and internal recruiting. Employee referrals are the company's number one source of valuable leads. Microsoft pays its employees a nominal "finders' fee" of $1,000 to $3,000. The company conducts recruiting events at which Microsoft

speakers talk about different technology areas and recruit interested participants. Microsoft recruiters also recruit at job fairs and use the Internet frequently for hiring purposes, both to advertise jobs and field inquiries. Recruiting teams screen applicants as quickly as possible, winnowing down to five to seven candidates. Candidates must be approved by the "bosses' boss," with offers made as quickly as possible (a few days to 30 days). The company tries to minimize its use of outside employment and recruiting agencies due to the substantial cost.

Contracting

Most businesses and government agencies contract out for some of their IT services. In general, companies prefer to keep people with skills at the higher end of the value spectrum as their own employees. They prefer that their own qualified IT employees develop specifications and make sure that outside contractors are delivering quality and timely products.

- *Sun's* VP says that the company does not like to contract out for skills. The company prefers to have its own people undertake new projects, thereby building capacity and accountability into the firm. Successful contracting requires that the company be explicit as to the contractor's role. Short term or marginal projects are likely candidates, as a contingency in case they are cancelled. Also, the company responds to fluctuations in lower level work through contracting.

- *Zilog* prefers to maintain a steady staffing level and to supplement with contractors on a project-by-project basis. It keeps a core of knowledgeable people to maintain control, particularly of architecture standards and strategy. Six months to a year is the preferable contract time frame. The company also contracts for skills it is having trouble recruiting and retaining.

- *Microsoft* contracts out for a wide variety of functions that are not within its "core competency."

Using contract IT consultants during periods of intense workload, and for special projects, is a way to avoid staff burnout. Professionals now comprise approximately 20 percent of temporary staffing services. However one writer cautions, "When you do bring in project professionals, it is important to communicate to your internal staff the reasons for the added support. Let your team know that contract workers are being brought in to supplement their efforts and enable them to meet critical deadlines."[42]

Retention

The fast pace of business and technology change, and corporate downsizing and outsourcing, have "broken" the old concept of a stable employer/employee relationship. Many highly skilled employees see themselves as free agents, particularly in the IT area. A recent study by the American Management Institute found that 46 percent of the senior personnel executives surveyed regarded retention as a "very serious" issue, and 60 percent thought skilled workers had become "scarce." The study identified training as

the most effective retention tool, followed by flexible work arrangements, tuition reimbursement and sabbaticals. Financial incentives ranked eighth and 12th in effectiveness.[43]

It is cheaper to keep employees than to replace them. According to a recent study, "...to replace a programmer earning $60,000, the company will need to spend between $65,000 and $75,000 in headhunter fees, temporary-worker pay, and management time."[44] New hires demand salary premiums of 15 to 35 percent in a market driven by skills. In addition, it takes time for a new employee to learn organizational routines and priorities. The organization also suffers from a lower skill level while it recruits and trains a new employee.

High turnover is often a symptom of organizational problems. Research finds that 85 percent of employees leave for the following reasons:
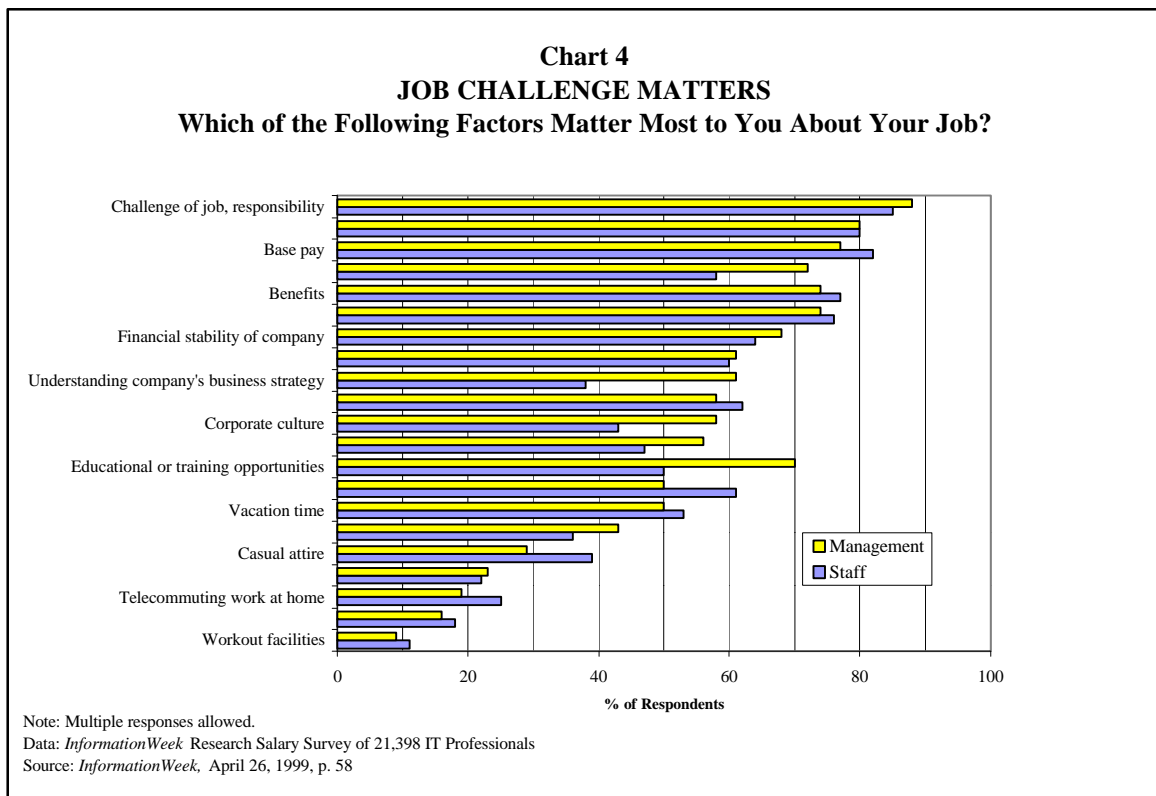
- Poor supervisor skills and attitudes,
- No perceived career growth opportunity,
- Inability to speak freely about one's concerns,
- The job itself,
- No salary increases, and
- Work schedule changes.[45]

Corporate IT managers are devising a number of strategies to build loyalty, improve job satisfaction and increase retention rates. They generally involve creating an attractive working environment and a competitive system of performance rewards. For example, stock options encourage employees to remain a minimum amount of time with a company in order to vest. Some widespread retention techniques include:[46]

- Hire talent from college and build loyalty through investment and coaching;
- Institute regular salary reviews;
- Create a corporate culture that empowers IT employees to actively participate in suggesting and implementing new ideas;
- Reorganize work—develop a corporate culture that promotes teamwork, not command and control;

- Offer more training;
- Pay bonuses for project completions and longevity;
- Create IT career tracks in which professionals can continue to develop their careers without having to become managers;
- Recognize excellence with non-monetary awards such as challenging new assignments, certificates of appreciation, better parking and celebrations;
- Offer flexible work schedules, telecommuting and family-friendly policies; and
- Appeal to higher values such as intellectual challenges, community service and the public good.

The literature stresses that a good IT manager functions as a coach, mentoring employees by promoting opportunities to gain skills and move into challenging new work environments. For example, *Corning* assigns mentors to new employees and trains supervisors to ensure that they are effective in introducing new employees to the corporate culture. This requires a company-wide perspective to career development, rather than a narrow department focus. The goal is to keep talented IT employees in the company, but not necessarily in the same unit. This requires grooming people in lower level positions and ensuring that they are able to take advantage of a solid learning program. The following chart, developed by *InformationWeek* identifies the job factors which matter most to IT managers and staff.

Chart 4
JOB CHALLENGE MATTERS
Which of the Following Factors Matter Most to You About Your Job?

Note: Multiple responses allowed.
Data: *InformationWeek* Research Salary Survey of 21,398 IT Professionals
Source: *InformationWeek,* April 26, 1999, p. 58

Several of the corporate executives interviewed for this report contend that a company needs to be able to promote from within its IT ranks in order to retain people. This

requires moving people around in the organization so that they can gain different skills and a broader appreciation of the company's total business environment. They prefer moving people with IT skills into their project management and business positions instead of vice versa.

Companies actively promote the growth opportunities they offer to qualified candidates. An advertisement in *The Economist* posted by McKinsey & Company seeks "Technology-driven business leaders":[47]

> McKinsey's Business Technology Office provides opportunities to develop the problem-solving and leadership skills for which McKinsey consultants and alumni are known. It also fosters the technology fluency we believe will be a distinctive characteristic of the next generation of top business leaders.

"Knowledge workers respond to inspiration, not supervision."[48] A good manager involves IT employees in envisioning how new areas of technology development can be applied to the organization's business, and includes IT staff in important technology decisions.

Xerox has an active IT employee retention strategy. The company administers an annual satisfaction survey and employee responses are closely evaluated. As a result, the company has developed a four-pronged retention program:[49]

- Working conditions—workers can telecommute, work part-time and job share.
- Skills development—the company funds training or education related to an employee's work, including pursuing certification or a masters degrees.
- Alternative career development options—for technical people who do not want to become managers.
- Profit sharing and bonuses.

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However a word of caution is wise—some elaborate retention efforts can backfire. They may create resentment in other areas of the company.

Training

Training is a valuable work and retention incentive. Investing in an employee's future may mean more than immediate compensation. According to a *Computerworld* survey, managers rank better training as their top retention strategy for IT staff.[50] *CIO Magazine* cites a recent survey that "supports the view that
companies with systematic approaches to development have lower turnover."[51] Employee surveys indicate that they place a greater value on career development than on making more money.[52] Investing in employee job growth is also the primary means by which companies gain new IT skills.

The *Federal Reserve Bank of St. Louis* has attempted to create an environment for continuous learning and growth in business and personal areas in order to retain IT professionals and to transform them from "technologists into business problem-solving

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partners." The bank's "vision for breakthrough performance" is summarized by these three key phrases:[53]

- *Learning to build a better future*: learning predicated on each person's desire to develop and grow on both professional and personal levels.
- *Learning what you need to know anytime, anywhere*: creating demand-driven tools for learning that are available when needed (rather than on a predetermined schedule) and wherever a person happens to be.
- *Learning beyond the walls of IT*: recognizing that everyone in the bank does IT work at some level and that the continuous learning environment must not be limited to the IT organization or to the classroom.

To accomplish this vision, the bank created a new IT team, Learning and Development Services. The bank offers a continuous learning network and on-demand courses to facilitate learning. An intranet site "…is the central resource for learning and growth information and events and hot links to learning sites, individual assessment tools, a project manager toolbox, learning assistance checklists for managers, a library of self-study courses and audiotape business books refreshed every 30 days."[54] Individuals are encouraged to form a personal learning agenda. The bank offers a variety of other learning opportunities:

- Bankwide Learning Forums presented by recognized experts,
- A Continuous Learning Network with self-paced learning through software,
- Business Awareness Breakfasts presented by internal business leaders,
- Career Power Workshops to help IT professionals set personal growth goals,
- IT Workshops for IT staff to improve skills by exploring new tools and techniques,
- Coffee Talks for information discussions to share best practices, and
- Training in Interpersonal Skills such as negotiation or conducting meetings.

Bank of America brings in vendors to provide internal training programs for new technologies. The bank first identifies employees who will provide technical support on a continuing basis, so the learning is supported. However the bank has backed away somewhat from providing broad educational support, as it finds it hard to retain employees when they have completed their courses. The concern is that a requirement for a one year commitment following training may not be enforceable.

At *Sun*, employees are responsible for their own careers. Career development is an important employee motivator. Sun University offers technical training courses and the company expects employees to attend at least 80 hours of supported training a year. When job needs and skill requirements change, the company works with employees who have older skill sets to find a new job, either in SUN or outside the company. The model is a military one, where employees gain new skills and are moved elsewhere in the company or are "guided" out and separated.

Zilog has a liberal education reimbursement policy for its employees. This includes working toward the completion of a degree. In addition, each employee receives two weeks of technical training a year at a minimum. The company spends an estimated $4,000-$5,000 a year on training per employee, not counting employee time. In the opinion of Zilog's CIO, a company must invest in its people or lose them.

IBM provides its employees with 40 to 80 hours of education per year, at an average cost of $1,500 a week plus salary. Some classes are offered internally and others are purchased from outside vendors. The company's policy is to "hire good people and train them." Employees are responsible for keeping their resumes (and skills) current.

Microsoft provides five weeks of training a year for its consultants. This includes formal courses, self-managed training on an internal network, and attending state and national conferences. Sales consultants receive two to three weeks of training a year, some technical-related and the rest oriented towards professional development. The company allocates a minimum of $3,000 a year per person to train its technical people, and around $2,000 a year for non-technical people (not including travel or salary). Most of the training is offered internally to take advantage of economies of scale.

Microsoft recognizes that its technical people want to feel like they are continuing to grow in expertise and value. Similarly, the company defines its jobs as entrepreneurial in nature, requiring individual initiative, accountability and ownership down to the lowest levels of the organization. Nearly three quarters of the company's employees are doing something different after two years, and are encouraged to gain broad exposure to a variety of areas in order to enhance their upward mobility.

Education and Training for America's Future reports that almost 90 percent of American companies believe that their employees need to improve their computer skills, while 60 percent think that their employees need to improve their analytical skills. The Manufacturing Institute, which sponsored the study, recommends that employers should invest "at least three percent of payroll to educate and train their employees," and that employees should also invest their own time and resources to maintain and improve their skills.[55]

Companies in high-technology fields spend more on training than any other industry group. A January 1998 study by the American Society for Training and Development found that "high-tech companies—in industries including computer systems, communications, biological and physical research, and drugs—spent an average of $911 per employee per year on training, more than any other sector.[56] Training can also be a low-cost incentive when employees teach each other. Brown bag lunches can promote learning and facilitate inter-office technology diffusion. Training should not be restricted to technical staff. One way to free up IT personnel is to make sure that nontechnical users receive enough training to perform their duties.

Training is critical to the success of any new IT project, yet is often not funded. The result can be a significant loss of productivity. Most organizations underestimate the people-cost side of an information technology project: "Industry analysts say hardware

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and software usually make up less than half of the cost of any information technology project over time."[57] According to the Gartner Group, an IT consulting firm, the total cost of someone using a Windows 95 PC connected to a network was close to $10,000 in 1998, of which the computer cost $3,000. The rest of the cost went to technical support, administration, and user learning.

Online training is a rapidly growing area. For example, online training is the most important use of *MCI Worldcom's* 550 intranet sites. MCI estimates that it has saved $111 million in training, travel and printing costs since it launched its intranet in 1994. Xerox estimates that its intranet has cut training costs for some computer classes from $105 to $2 per user.[58]

Some companies have entered into training partnerships with colleges to ensure that graduates have usable skills. Others have set up private programs to train unemployed, disabled and under-employed people, for example as systems programmers.

- The regional Workforce Partnership of Joint Venture/Silicon Valley has formed a collaborative among local colleges and the semiconductor industry in order to alleviate the immediate high-tech worker shortage and grow a future workforce. The Partnership has held three career-development job fairs to tell students about career opportunities and the degrees required to get them.

- According to CEO John Chambers, Cisco Systems has Networking Academies in all 50 states. For example, the company recently signed an agreement with the Colorado Community College and Occupational Education System to bring the Cisco Networking Academies program to the state. The company will contribute a web-based interactive curriculum to teach a broad array of IT skills, will provide equipment and resources to 13 colleges, and will train selected faculty.[59] Microsoft and IBM, among other companies, have similar programs.