

# SAS Skills for the Next Millennium

not so distant

A geek peek into the future

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## Abstract

Whether you are a new SAS user, an accomplished developer or a manager responsible for recruitment and selection of SAS talent, you will be interested in this look at what it takes to be a SAS programmer in the Year 2000 and beyond. It is a compendium of quotes and commentary for SAS programmers (or anyone for that matter!) to think about that helps you focus on what skills will be in demand. Most of this paper is centered on non-technology specific concepts, although there is some discussion about specific SAS skills we think employers, clients and partners will seek.

## Introduction

*Skill shortages. IT wage inflation. Urgent work.* These phrases may sound musical to the ears of IT professionals, whose skills, knowledge and abilities are in a seemingly long-term demand phase. Making a decent living and no real worries about ever being out of a job is a reasonable prediction for the vast majority of professionals and managers who know the importance of their own continuing IS education. Reports from numerous sources site the crisis with alarming tone.

"Britain's IT industry is plagued by severe shortages of skilled staff. Wage inflation in this sector is between two and four times the retail price index." (Taylor 1997)

Industry analysts have expressed their own speculations about the reasons for the critical shortage of IT professionals. Some site the European Monetary Union (EMU) which will affect companies that trade internationally, the global acceptance of client/ server applications development standards and even the Year 2000 Crisis for example.

"One key reason that the services market is heating up is the shortage of people with high-level IT skills. IS organizations are stressed out trying to attract and retain the skills they need. Year 2000 conversion work, for example, is 'sucking up all the supply of skills needed for other projects. The high wages available for year 2000 work has a ripple effect, raising wages for programmers on other projects, such as system upgrades." (Kavanagh 1997)

Regardless of the reason for an IT labor shortage, we as technical personnel in a highly evolving environment need to "keep up" with the industry. Keeping up doesn't mean knowing the latest programming technique or having expertise in every web-based technology. Rather, this paper discusses the required knowledge, skills and abilities as it relates to success in the field of information technology: Both the soft skills (i.e., problem solving, interviewing) as well as the specific technical skills.

This paper is divided into three sections. First we provide a macro-level view of the changing workforce and the

implications for organizations, employers and technical personnel. Second, we examine some of the "soft-skills" that will be necessary to compete in the future. And finally, we discuss some of the specific technical skills that make excellent SAS programmers stand apart from a good SAS programmer (regardless of certification.)

## Methodology

Throughout this paper, you will see quotes that are self-contained as in:

*"Experience in multiple fields of endeavor outside computing"*

*Bob Stearns - Guru, mentor and book collector*

In 1997 and 1998 we e-mailed approximately 100 people whom he considered to be leaders in the SAS community. In that e-mail, he asked, "What skills do you think will be required of SAS programmers in the next millennium?" No additional help or clarification was provided. The quotes used throughout this paper are a result of that effort.

## Trends in employment

### The changing workforce

As the baby-boom generation (1945-1964) approaches their mid-30's to late 50's, a new generation of employees is emerging in the workforce. This new generation, often called Generation-X, has grown up entirely in the color-TV, Nintendo, GUI, multi-media environment we call home. If it doesn't flash, blink or have 65 millions colors and blast in dolby surround sound, it quickly gets dropped. Call them the attention deficit generation. The Generation-X workforce has challenged today's organization with shorter workweeks and ergonomic workstations. Telecommuting and teams predominate.

The average age of the American worker continues to increase. A startling testament to the aging of our workforce is that 40 percent of U.S. workers (55 million) will be over 60 years of age in the year 2015. The net result for the IT industry is a shortage of the skilled labor force, which, is in part related to declining U.S. birth rates.

In addition to Generation-X'ers, our workforce is changing with the entrance of an extremely diverse employment pool. The diversity of the workforce population has been projected by organizations such as the Hudson Institute for years (Johnston and Packer 1987).

Although understanding and anticipating racial, gender and national origin shifts in the workforce is important for today's

manager, other aspects of "diversity" include age, religion, disability or special ability, sexual orientation, beliefs, values, language, and cultural "ways" (such as lowering ones eyes when speaking to others, dress, physical distance, and not speaking up when a superior is wrong.)

On top of these complexities, layer on the fact that today's workers do not have one shared set of circumstances. For example, each of the following characterizations of the best workers in a services provider office illustrate radically diverse needs and wants:

Tomas has two children who live two states away and whom he wants more than a weekend to visit every month.

Vanessa has asked to travel in the past, but her mother is aging and most recently taken ill.

Patrick's wife (who works at another company) has been placed in Manhattan for 4-6 months, and his two under-5-year-old children are remaining with him.

Sean has recently developed repetitive movement injury.

Ming has been quietly lobbying for more time so she can get her graduate degree.

The world around us is changing. About two-thirds of all new labor force entrants will be female in year 2000 and beyond. An increasing number of immigrants are projected in the U.S. More than 55,000 foreign-born professional came to work in high-tech industries, on H1-B visas. And projections call for 115,000 H1-B visas to be issued in 2001. The 1998 cap of 65,000 H1-B visas was reached in 1998 after only 5 months. The majority of these high-tech visas are Indian (44%; (Mehta 1998)). Another trend that we are seeing which inevitably affects our workforce is the fact that there has been a dramatic increase in two-parent wage earners.

**What does this have to do with me?** Whether an owner, manager or a non-managing professional, everyone is part of the profitability picture. Whether a good employee -- domestic or foreign -- will want to be recruited, hired, and retained by any organization has much to do with the characteristics of the individual members within that organization.

### The changing workplace

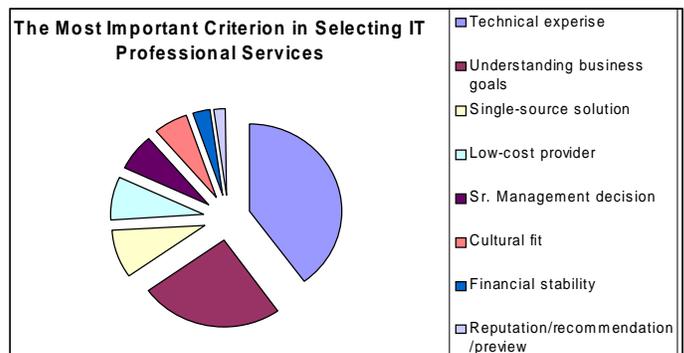
The workplace will be as different as each of the workers inside. For instance, for some workers -- both full- and part-time -- the workplace will be a variety of different work sites with a modem connection. For others, work sites will migrate to where the biggest demand for services are. The "traditional" office, with its Traditional 9-to-5 requirements will continue to exist, but mostly in locations close to where clients are being serviced. Some professionals who work at headquarters or other centralized offices will find employee headcount reduced through attrition, revamping jobs, and outsourcing. Successful U.S. businesses will continue to look for ways to keep good employees by meeting their needs (e.g., location preferences, flexible hours) and reducing swelling overhead, especially in big cities where real estate continues to soar. No longer will the magnitude of its structure or the acreage of its campus reflect the success of a company.

## The Changing Organization

Making a reputable and lasting name for oneself as an IT professional, and getting top dollar for one's services, is not going to be as easy as keeping up with technology. In fact, technical expertise accounts for less than half of the criteria for selecting IT services.

According to Dataquest, as cited in (Caldwell and McGee 1997), a vendor's technical expertise and *its understanding of clients' business goals* are the most important factors in selecting services providers.

The Most Important Criterion in Selecting IT Professional Services (from Dataquest survey of 191 IT executives).



As supported by these data, numerous organizations are looking for partners, vendors and contractors who can contribute beyond simply providing core technology services.

Aside from sound technical *skills*, the most successful professionals will possess two other critical attributes: *knowledge* and *abilities*. Below are six predictions from experts, practitioners, and researchers that successful professionals will possess.

1. Obtaining the knowledge of different industries, as well as a greater their own.
2. Being or learning to be a one-person learning organization. In other words, becoming adept at processing different types of data and concepts, while drawing upon past learning and experiences.
3. Having the ability to think as a "mini-corporation" as well as a full-fledged team member within the group. Getting rid of the notion that being individualistic, as most Americans tend to be, precludes one from being a team member who is able to realize the rewards of collectivism.
4. The ability of flexibility in all aspects of work (and personal life).
5. Learning the art of creativity, new ways of thinking, building, problem-solving.
6. Communicating ideas through verbal, non-verbal and written modes.

## Outsourcing Trends

Many assume it is a programmer's paradise. In Raleigh, N.C. alone, over 1500 open positions are posted on a popular job web site. Based on anecdotal evidence, it appears that most positions are for consultancies: Organizations that help others put the technology to work. This also appears to be the trend in employment.

"While the IS skills shortage also affects services vendors, there's a difference: Because skills are directly related to profits at services vendors, the vendors offer better compensation packages and opportunities for advancement than IS organizations do to attract and retain skilled professionals." (1997)

*"The growth of SAS specialists should mean that most SAS sites will be forced to rely on outside consultants for expertise rather than internal talent. In order to receive appropriate compensation for their skills, more experienced SAS "programmers" will probably be consultants rather than employees. The demand for these specialists should also translate into recognition of their skill sets through higher fees comparable to other consulting specialties."*

**Dave Riba - Consultant**

Outsourcing is an obvious trend. Organizations cannot expect to house all of the talent required to make a complex system run 7 by 24. Examples include everything from outsourcing complete IT functions (including the operations of its data center), to complete projects, to work-for-hire consultants who sit next to your permanent staff.

*"Future SAS programmers will basically work as consultants on a project by project basis; most likely for consulting companies for the next 5-6 years, then the shift will be to "expert" teams. A programmer will be invited to participate on or lead a team depending upon their experience and knowledge. They'll be involved in several at a time, and have different responsibilities on each."*

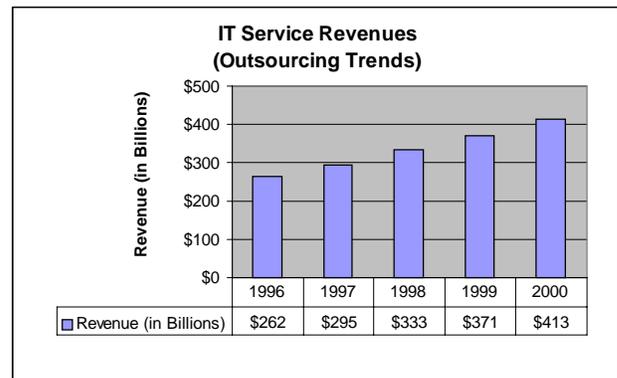
**Diane Searfoss - The Gallup Organization**

IDC predicts that outsourcing will grow by 60% by the year 2000. An estimated 90% of Fortune 500 firms currently outsource at least one function and almost half of these firms outsource payroll (Himmelberg 1997). Total revenue for all IT services companies will reach \$413 billion worldwide in 2000, up from \$262 billion in 1996 (Caldwell and McGee 1997).

This trend demands that employees be constantly trained to become flexible, a trait preferred by employers so that they can match up skills with projects on an as-needed basis.

"A consultant brought in by the brass addresses a group of managers and {SAS programmers}. To improve the companies business processes {in their data warehouse project}, he says, "I'll show you how a well designed {data warehouse} can compensate for your sloth, apathy and all-around incompetence." There is a deadly pause.

The consultant adds, "But most important. Let's have fun" **Scott Adams- Creator of Dilbert**<sup>1</sup>



## The virtual organization

Managers who "can't get used to" the physical absence of employees who work a few miles or states away would be advised to consider several things. First, realize that telecommuting and other temporary forms of being away from the office are not trends, but realities. Physically visit with and talk to other managers who are ultimately responsible for the work of telecommuters and other contracting arrangements (e.g., job splitting). What works for them? Perhaps more importantly, what does not work? Look for information and guidance on the Internet. Finally, SAS-L L (an internet listserv group for SAS Users) has some interesting dialogues periodically about telecommuting and how to deal with perceptions of low productivity, time management, etc.

*"I believe there will be a growing number of SAS programmers working from home, your own personal island, boat, plane or maybe even Mars. We'll use SAS on the Internet to retrieve assignments, work on assignments, provide progress, and submit completed assignments. Our video, audio, and communication capabilities will allow us to teleconference (via satellite or some other mode) easily and cost-effectively."*

**Kirk Paul Lafler - Consultant**

The virtual organization is quickly becoming a reality. We saw this in academia in the late-1980's with the wide acceptance of e-mail and listserv's, researchers in far reaching places could now participate in joint projects with colleagues. As organizations downsize, rightsize, and globalize, the boundaryless organization becomes a reality (Barnes Nelson 1997).

*"The programmers will be in a "loose-team" environment, which means they'll be telecommuting--most likely from home (and per my request --NO VIDEO-Conferencing!)."*

**Diane Searfoss - The Gallup Organization**

<sup>1</sup> Note. {Emphasis} added by the authors of this paper.

### Changing structure

Organizational structures are quickly changing. In fact many organizations have stopped trying to produce formal organizational charts, but have opted for project teams that have their own life-span.

Several examples that provide evidence of the shift in organizational structure can be found in use of self-directed teams, matrix models for managing project-teams and managing when you're not in charge. (Fisher and Sharp 1998)

### Changing relationships

Finally, organizations will have more opportunity to focus on "whom" they work with. Shifts from traditional human resource (HR) practices to strategic matching models encourage examining the fit -- from both employee and employer vantages. As the strategic-matching model below might suggest, when organizations and individuals find a better fit between each other, elevated productivity, satisfaction and reduced turnover can result.

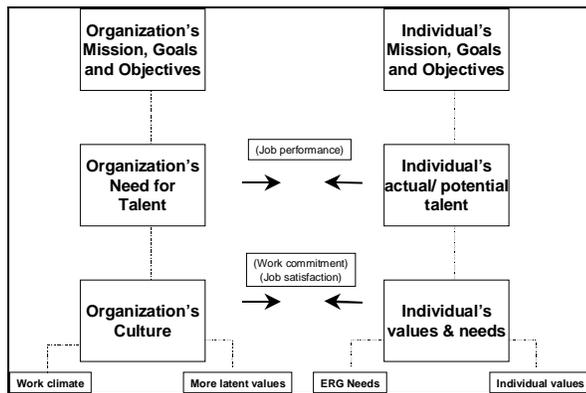


Figure 1. Source: (Barnes Nelson 1999).

### Technology Shifts

*"Shouldn't we be closer to the Jetsons as we approach the turn of the century, but in reality we seem more like Mad Max?" Unknown Comedian*

Earlier, we focused on the macro level. We looked at what industry analysts suggested would be the trends in employment. Let's now take a look at what impact technology might have on the desired knowledge, skills and abilities.

For the past thirty years, we have been fighting to catch our breath. Technology changes faster than we can adapt. It wasn't but a few years ago that we thought of 1999 as the science fiction future. Today we are deluged with information about information and have come up with an entire vocabulary to account for things that we never imagined: metadata, data warehouses, Intranets, web-casts, servlets. The list goes on. Later we discuss the concept of keeping up, but here we will focus on the specific technology trends that will affect our evolving work lives.

*"Concepts like data warehousing and data mining are what SAS users have been doing for years. Don't get bogged down in terminology.*

*"Information systems, Decision support systems, EIS, Business Intelligence, OLAP, and Data Mining are all forms of applying analysis to data to turn it in to something useful. Gee, by 2000 we will probably call it Ocean Systems. This will account for the large volumes of salty water (data) that must pass through desalination plants (data warehouses) to produce potable water (knowledge) so our businesses can grow only to produce more salty water."*

**Keith Collins - R&D Strategist - SAS Institute**

The previous quote symbolizes what many respondents communicated in our informal survey: That the world around us is changing dramatically, but the basic computing problems are still manageable. New terms and definitions grow out of our need to communicate with one another. Let's take a look at some of these technology changes.

### Software technology

One of the respondents from our e-mail survey sums up the power of the software.

*"I remember when I soldered together my first computer in 1977 that the manual said I just had to get past the hardware part of the computer because I could do anything I wanted to in software and never worry about blowing up the computer."*

**Henry Feldman - Developer of DBMS/Copy, father of twins and actor**

Of course, we know that you can't do everything with software, but it's clear what impact some of the software programs of our generation have had on how we use computer. Imagine a computer world without Microsoft Windows or the Macintosh user interface. The standards set by Microsoft Office continue to amaze, as clients' demand that their SAS application look like Microsoft Office applications.

### SAS Shifts

SAS Institute has done a tremendous job in its ability to mature and evolve as the industry has grown. In 1986 when one of the authors first was paid to do programming in the SAS language, about 95% of the use was in DATA and PROC steps. Very little was being done with SCL. It wasn't until 1994 that SCL lists and methods were being utilized in mainstream applications. In 1995 with Version 6.10 we saw objects being employed. SAS 6.12 really was SAS Institute's first foray into formal object oriented methodologies. It was in that same time period that we saw things like Web enablement technologies (html formatting tools, SAS/IntrNet), new interface components (Import/ Export Wizard & Viewtable) and finally end-user products (CFO/Vision, Enterprise Reporter).

Finally, Version 7 was released in December 1998. With the introduction of a true object oriented environment, we now see support for a new object model for classes; a flexible Output

Delivery System (ODS); long filename, variable names, data set names; native API's for relational databases; and object support for COM, CORBA, ActiveX.

All of these things will have an untold impact on the people who use this technology. In large part, this will be determined by the scope of its acceptance in the SAS and larger information technology landscape. However, these things will inevitably make their impact mostly on the SAS programmers' adaptability and marketability.

## Hardware

People who specialize in hardware configuration, systems architecture, RAID controllers, capacity planning and performance are a rare commodity. People who specialize in those things AND know something about optimizing SAS are even rarer.

Although no one in our survey mentioned hardware specifically, this area is something that is especially close to one of the author's hearts as it is something that is often overlooked and very much needed in larger IT and SAS shops.

## Platform trends

Somewhat related to the concept of hardware, is the notion of platform. What we mean is where things run (server) and where we run them from (client). As is true for the rest of the industry, SAS applications were once both launched and executed on the server (usually a mainframe). In the late 1980's and early 1990's, we saw a shift to client-centric applications. Today, the pendulum is shifting to a more realistic model where the applications are being launched from clients (windows-centric, web-centric and Microsoft-centric applications) and executed on massively parallel, multi-processor servers.

*"SAS programmers in the new millennium will use a new generation of tools that allow them to quickly build systems to access the analytical power of SAS servers. SAS programmers will deliver thin WEB applets for lightweight decision support systems as well as heavier highly interactive systems using AF & Java to script SAS components."*

**Keith Collins - R&D Strategist - SAS Institute**

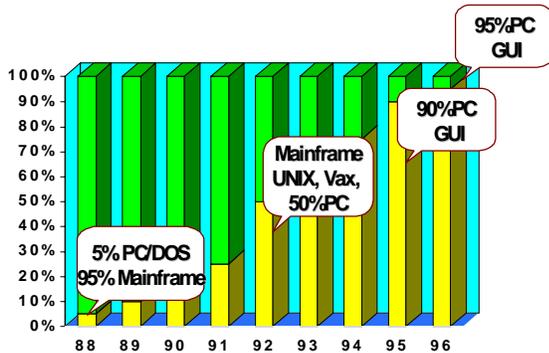


Figure 2. Mainframe in a server role.

*"SAS programmers will need to be multi-operating system fluent. No longer will MVS and JCL cut it. While these may still be important, SAS programmers are going to have to be network-competent, and be able to develop applications that will run on PCs, OS/2, OpenVMS, \*and\* MVS."*

**Jodie Gilmore - Freelance Technical Writer**

*"The SAS Programmer of the future will be spending time writing applications that deliver information over the Web. It will be like the old days, with big machines in some central location crunching vast quantities of data and sending formatted reports back to the requester. Fat servers, fat networks, and very thin clients."*

**Chris Toppe - AT&T Corporation and wine taster**

As this trend continues, the need for individuals well-versed in JCL, UNIX shell scripting, and graphical user-interfaces continues. Those with experience on multiple-platforms will be sought after.

*"..even though 2000 is only a few years away, big iron and batch submission and writing code will still be with us for quite a few years after that, I'm willing to bet. Therefore, I feel that it would well behoove any new SAS professional to firmly ground him/her/itself in the SAS basics - just what is happening under the covers, in the mysterious PDV, or whatever it will be called in the next incarnation of the system. If new SASventurors don't continue to learn about about IF, THEN and whatever ELSE, then OOPS will revert back to its old meaning more and more - Oooops!"*

**Ray Pass-Consultant**

## User-Centric applications

As was mentioned before, Microsoft has changed the way that we think about computer applications. Both from a design perspective and user perspective, we see the need for good applications developers who can

- write good help systems
- that are intuitive
- and easy-to-navigate.

*"The SAS programmer of the future should plan to be versed not only in how to produce information, but in how to format that information for different users. The programmer should take into account both the personal characteristics of the audience and the functional position of the user. This means understanding both the science of human perception and the business position of the person using the information."*

**Judy Loren - Consultant**

*"SAS programmers must learn to develop full-screen applications. The post-2000 user will not be satisfied with command-line-driven applications. They want bells. They want whistles. They want complete on-line help."*

**Jodie Gilmore - Freelance Technical Writer**

*"SAS has often been criticized because our UI for examples 'Does not look like <pick a platform>'. "Well with the UI {user interface} now owned by some "independent client" the playing field has now been leveled. Now the competition is on the back-end processing capabilities of the software. That is an area where SAS really excels (no pun intended).*

*"So, if I was a SAS consultant, I'd keep up to snuff on the processing power of SAS and pay close attention to building client-centric UIs."*

**Don Henderson - SAS Institute**

## Emerging technologies

Just in the last five years there has been an emergence of new technologies, the bar has been raised in terms of both users and businesses' expectations. In these short years we were introduced to the majority of all of the web technology that is current, data warehousing, data mining, the next generation Microsoft GUI (and subsequent expectations about user interface design).

*I think that SAS Programmers in year 2000 will be focusing on Web Enablement applications that can be run using the new wave of thin client PC's. These PC's will be tied to large servers that will allow companies to go back to central control of data and applications like they had with mainframes.*

**Herb Kirk - Vice President - SAS Institute and fisherman**

A survey conducted in the UK job market indicates a need for networking and communications (i.e., Microsoft NT), intranet development and support and Oracle development tools, (Gold 1997).

*"I'd recommend extending your business issues knowledge in the area(s) you work, learning additional operating systems, relational database concepts, applications development ("JAD", "RAD", and "Business Systems" are the general buzzwords), and a "real programming language" (read "compiled") or three. Oh yeah, probably Web stuff as well.*

*"Business knowledge: scan the trades, understand management speak, learn to like people (or at least make them think you do), know the "accepted analysis" practices in your area. Despite the emphasis of ads on specific skillsets, it's going to be your general people skills, ability to think, and ability to learn, that will provide you the maximum mileage."*

**Karsten Self - SAS Guru and friend (Linux junkie)**

1. Java skills
2. Object-oriented programming skills
3. Web applications development
4. Wit of Mark Twain
5. Flexibility of Silly Putty
6. Wisdom of Solomon

**Joe Carter - Web Technologies Developer**

Again, from a new technology perspective, there is more opportunity than ever to learn about and browse the bookshelves of our local bookstores.

## Year 2000

Throughout the literature in both the United States and the United Kingdom, we see reports of the IT labor shortage. In large part, many of these reports indicate that the year 2000 crisis is primarily responsible for these shortages. Although we don't subscribe to this belief ourselves -- there is plenty of evidence to suggest that the emergence of new technology has slowed its pace to respond to the Y2K crisis -- we acknowledge that the Year 2000 will have a significant impact on computing and the people that ride them.

*... "the programmer must travel into the future .... All of his programming skills will be put to the test. "*

**Sunil Gupta- Year 2000 Project Specialist**

*The SAS programmer in the year 2000 thousand will be still be slaying the cobol beast, running circles around the "operational system architects"*

**Keith Collins - R&D Strategist - SAS Institute**

## Back to basics

When it comes to SAS programming, there is one constant - the DATA STEP. Whether you write reports for claims data in a Health Care organization or build data-driven applications for interactive use, you will most likely use the basic data processing in SAS to accomplish your tasks.

*"The SAS Programmer of the New Millennium will have strong knowledge of the basic data step and language rules as well as a solid understanding of the underlying SAS procedures in his or her area of expertise. In addition, knowledge of presentation programs such as TABULATE, REPORT and GRAPH will be necessary to assimilate the analysis into the business decision process."*

**Olivia Rud - Data Mining Specialist and Healer**

*"While the new millennium will continue to bring new buzzwords and technologies, let's not forget the basics. Good skills in program design, testing, problem recognition and problem resolution will continue to be in high demand. Those who lack these fundamental skills will continue to have problems, regardless of how "up-to-date" they are technically."*

**Mike Rhoads - WESTAT**

*"I think we are going to continue a phase of getting back to basics. All of these new fangled products will continue in certain sectors of the market, but there are other strong contenders that are cheaper and do the job better."*

**Janet Stuelpner-Consultant and traveller**

## The Changing IT Professional

Let's now shift from focusing on the macro level to a personal level. What do I need to be a successful IT professional? More specifically, what *knowledge, skills and abilities* would be useful to me as a SAS programmer/developer? Here we combine what industry analysts, researchers, and surveyed colleagues suggest are most important.

The bottom line is that good technical skills go a long way; however, as corporate use of technology matures in the next several years, other skills, knowledge and abilities will be required. Below are some of these.

### Adaptability

- Flexibility in ways of perceiving stimuli, in creating, developing, and executing ideas.

Ridding oneself of job-defined/ task boundaries and territorialism is a great start. One of the author's all-time favorite SUGI papers is by Art Carpenter, who shows people how to program for job security. The paper is full of all of the things people in teams should not do. Further, the paper promotes obscurity so that no one will ever figure out what you've done. Of course, the irony is that instead of increased security, your future is jeopardized.

*"Ability to adapt. Things are simultaneously standardizing and changing. For example, the Web is now popular, so the browser is the UI. But things are changing so quickly that there really is no stable standard to work towards."*

**Don Henderson - Web Guru - SAS Institute**

As one writer states, "If you're fighting for job protection, you're doing 19th century work" (Himmelberg 1997), this will cause things to slow down and then you'll find out that no one is looking ahead. In the information technology field, people need to be looking ahead, adapting and, we would add, telling someone how to do your job, so you can move onto the one you really want.

*"Probably the most important skills a SAS programmer should have in the year 2000 and beyond are the ability and willingness to change and adjust to new technologies."*

**Aiman Zeid - Consultant and father**

### Problem solving/self-educating

- Ability to investigate and understand myriad facets of a work problem or issue.

Perhaps the most interesting finding in our survey is that responses did not echo "go out and learn Java, HTML, JavaScript, Visual Basic or Oracle." Although these things were mentioned, what was mentioned most often and most prominently was good basic problem solving skills. Knowledge and abilities that could easily translate into other professions -- accountants, teachers, scientists -- such as "problem solving," "broad experiences outside your field of endeavor," and "willingness to try new things."

*"The ability to generalize a problem and then solve the general problem"*

**Bob Stearns - Guru, mentor and SCI-FI nut**

In fact, the authors' personal feelings as hiring managers are that we would rather have someone who could do just what Bob described rather than someone who codes well. After all, we can always teach someone the syntax for PROC TRANSPOSE, but it's awfully difficult for a person to realize that the problem is one that can be solved by that particular procedure.

*"The ability to solve problems and adapt to a changing environment. The focus of problems has shifted from data processing to providing user access to data manipulation, but the data processing problems have not disappeared. They are now buried in the GUI."*

**Ian Whitlock - Mentor, friend and teacher**

Ian describes something that seems simple and elegant. If you ever have had occasion to read one of his postings on SAS-L, then you will realize the power of this statement.

*I have a willingness to try things. What I mean by that is if I am curious how a particular function works I will write a little program and play around with the parameters. Many people (I know this from doing technical support) will ask some one how the function works or call technical support. I find the experimenting leads to greater understanding. Understanding leads to having a vision of multiple ways to solve a task.*

**Henry Feldman - Developer of DBMS/Copy, father of twins and actor**

As a member of a Help Desk community at the University of Georgia, this was the bane of one author. Daily, people would call and ask, "what does this PROC do?" Or "What would happen if I pressed the F9 key?" His not-so-probing answer would often be, "I don't know, why don't you try it?"

People need the confidence (and the environment) to learn from mistakes. Just like a gymnast who is not afraid of the high beam can perform amazing feats, programmers can do amazing things if they aren't afraid to try.

*"If I had to identify the most important skill/attribute required of a future SAS programmer I would say it would be the ability to keep learning & growing. Once you stop learning about the new bells and whistles, the new tricks of the trade -- because "you're too busy"-- you will stop growing as programmer and be less effective. Periodically, I take the time to "play" with SAS products or procedures I haven't used yet just for fun..... It is up to us, however, to learn enough about them to know if we should fit them into our toolkit or forget about them. "*

**Mic Lajines - Statistician, SUGI 98 Conference Chair and Soccer nut**

*"SAS programmers will need to fight career inertia even more than ever. While it is tempting to "know what you know and do what you do," the code-development world is so fast-paced nowadays that a person has to be learning something new all the time. It's exhausting and sometimes inefficient, but necessary."*

**Jodie Gilmore - Freelance Technical Writer and mom**

## Communication

- Communication skills (beyond computer languages): Ability to articulate what problems exist, proposed courses of action, persuasive skills to internal and external stakeholders.

Included in communication skills are writing (composing letters, bids, feasibility studies, anything to do with stakeholder contacts) and non-verbal communication. Nonverbal is always important, but it is crucial in a multi-cultural workplace.

An American Society of Personnel Administrators study reported that the reason most professionals and managers fail -- more than technical deficiencies -- is due to inadequate verbal and written communication skills. [Finney, 1995 #232]

## Thinking like the boss

- Becoming an entrepreneur in ways of thinking about "how can we make this arrangement work for all parties involved?"

Taking personal responsibility for issues such as quality products and processes, relationships with stakeholders, and other improvements.

## Beyond Technology: The Learning Individual

- Integrating knowledge into a second-hand nature of learning -- of recycling knowledge and complete patterns of

what was learned before, presently and how these can be applied to future problems and issues.

*"Experience in multiple fields of endeavor outside computing"*

**Bob Stearns - Guru and mentor**

*"The ability to get the user to ask "what" rather than "how"?"*

**Bob Stearns- Guru, mentor and tact-challenged co-worker**

*"The SAS programmer of the New Millennium will have to think precisely at a level of abstraction that spans discipline as well as system boundaries. In contrast to extended operating systems (MS Windows) or extended RDBMS's (Oracle, Sybase, etc.), a programmer using the SAS System has access not only to data objects and relational logic but also to statistical, OR, and AI methods. To take advantage of the scope of the SAS System, a programmer in the 21st century will have to conduct an orchestra of methods."*

**Sig Hermanssen - WESTAT and SQL biggot**

*"The SAS programmer of the New Millennium will, of course, need to be the master of the wide variety of tools for data transformation provided in the SAS System. But more importantly, we will all need to develop a better understanding of the nature of information itself. In many ways, there will be a shift in focus from the tools and techniques towards the desired results, from Programming towards Knowledge Engineering".*

**O.V. Hanger - SAS Guru and student**

*"I think people are expecting more and more of computers, languages are getting more and more powerful and allowing incredible results to be produced with little effort. This means that if a SAS programmer is going to be worth employing, they are going to have to be able to produce something much more than what the software churns out easily."*

**Phil Mason - Consultant and father**

## Solutions Orientation

*"... I think that the most valuable skill that "the SAS Programmer of the new Millennium" should hone is the ability to develop applications with SAS that solve business problems and help meet business needs."*

**Debra Pierce - Marketing Analyst - SAS Institute**

*"...there'll be a more defined split between SAS users and SAS programmers. The SAS users will primarily be statisticians who will use a basic set of procedures for analysis and provide expertise in the areas of sound statistical processes, for example sampling, imputation, and weighting. There'll be some major applications (similar to the way Assist is used) needed for VERY quick but intricate statistical analysis, either written by the SAS Institute or Development type company."*

**Diane Searfoss - The Gallup Organization**

## Specialization

We have seen the focus on specialization in our own industry. For example, being Microsoft "Certified" now means deciding on eight different certification paths -- from the person who installs the operating system, to the developer who build an e-commerce solution. You just can't know everything. In the SAS world, we have been exposed to over 25 different modules and/ or packages. From advanced statistics to project management, no one can ever be a true expert in the entire SAS suite of products.

*The "traditional" SAS programmer will cease to exist. Where once it was sufficient to know Data Step programming, Macros, Graph, and Stat, SAS programmers of the future will become much more specialized and niche oriented. Statistical use of SAS has always been a specialized niche. In the future, you will see specialties including GUI design, SCL programming, data warehousing and mining, Inter- / Intra-nets, and specific SAS vertical market applications. With the continued complexity of the SAS System, programmers will need to develop a more in-depth knowledge of smaller parts of the SAS System. It will be virtually impossible to become a generalist in the entire SAS System. Additionally, the term "SAS Programmer" will probably become a misnomer. With "point and click" GUI front ends. SAS procedures like SQL no longer require programming to achieve results.*

**Dave Riba - Consultant**

## Working Styles and Reputation

Inevitably technology will pass us by. The emergence of new technologies is outpacing our ability to "know everything". People need to work smarter, not harder. Some of the most successful people in our industry are not those that burn the candle at both ends to try and keep up. Rather, it is people who understand the importance of good problem solving and thinking.

*"Historically we looked at whose cars were in the parking lot at 7p.m., and we made the assumption that they belonged to corporate heroes hard at work," says Randall Tobias, the CEO of Eli Lilly. "In truth, some of those people were probably poorly organized or spending time on the wrong things. We have to get more focus off measuring activity and onto measuring results - not the number of hours put in but what gets produced."* (1996)

Those that have and hold relationships with people and endeavor to get out of their own boxes will be successful. In a recent article in Info World, one author suggested that "hard work, technical skills and education are all important. But experts agree that your reputation counts just as much. So whether you are striving for a promotion or simply want to be heard at meetings, you may want to try beefing up your public relations efforts instead of signing up for another technical seminar." (Jacobs 1999)

*"I think as time passes and the employer has higher expectations of the SAS Programmer, personality becomes an important part of the job - almost the most important part. After all, how important is the work really if there is poor communication and little respect?"*

**Nancy Patton - Consultant and Telecommuter**

## Summary

Change is inevitable. It's not how you deal with change, but rather how you accept it. Because of the diverse workforce, the entrance of Generation-X, and advances in telephony and networking systems we are seeing higher demands for individuals skilled in communication and problem solving. The need for specific technology skills, the concomitant shifts in the way that we work, who we work for and what employers find indispensable will have untold impact on what the next millennium brings. There will be, of course, a need for the *thinking* consultant. The higher level analyst who not only knows how to program the solution, but also solve the problem.

This paper has attempted to outline some of these shifts and how you as an employer and employee can respond.

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