Integrating SAS® in Corporate IT

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Abstract

Applied users widely recognize the value of information delivery using SAS software. Integrating SAS into the business increases and streamlines productivity. However, limited awareness may exist in corporate IT of the role these tools play in knowledge formation for business solutions. The undervaluation of SAS stems from historical use by researchers, rather than IT developers enamoured by new technology. This can be remedied by raising corporate IT's awareness of cutting-edge SAS tools and the value of their adoption for timely solutions to a growing range of tasks. We discuss issues associated with raising corporate IT's awareness of the power of SAS software.

Introduction

Difficulty integrating SAS in corporate IT has several origins. First, its initial development was for use as a standardized set of statistical procedures for statisticians supporting research at land-grant universities. Funded as research at North Carolina State University, it was privatized in 1976 as SAS Institute, Inc. (SI). Although the software suite has since grown immensely, many (including traditional users) still view it predominantly as *statistical* software.

Traditional customers have *not* been corporate IT, but rather academic and corporate R&D. Corporate IT frequently supports SAS only because R&D *insists* it has to have it installed on corporate IT hardware.

Second, corporate IT tends to focus on public companies; either acknowledged giants (IBM®, Sun Microsystems®, HP®, Microsoft®, Oracle®) or startups with hype and a fast-moving IPO. SI, though privately held by two individuals, is stealthily moving into their ranks. It exceeded $1B in 1999 revenues and is reportedly considering a partial IPO. However, many in corporate IT do not even know SI exists, much less understand its products and services. While problematic, this *knowledge gap* is changing.

Perhaps most interesting to non-users is that SI's steady *slow growth* is by plan. Lane (1996), Fishman (1999) and Zuckerman (1999) strongly reinforce this hypothesis. As CEO Dr. Jim Goodnight states, since its inception "SAS Institute has been growing one or two employees a day for many years, we build buildings one at a time. From my perspective, nothing really changes, it's just a constant evolution" (Zuckerman 1999). Users can vouch for this, as attested by the annual SASWare Ballot, which results in user-requested software modifications. Other examples include the rewrite of SAS code to MultiVendor Architecture™ in the 1980's and the addition of the Output Delivery System (ODS) in the 1990's.

That SAS software is evolving is also seen in the Institute' s marketing approach; from day one, its software has been licensed on an annual lease basis. Since 98+% of customers annually renew leases, the Institute has enjoyed a solid revenue stream. This allows smooth growth, creation of excellent products and superior support through re-investment of >30% of annual *revenues* (not profits) in R&D. Compare this to the typical research-based pharmaceutical company's average percentage of sales re-invested in R&D at approximately 20% (Pharmaceutical Research and Manufacturers of America Annual Survey, 1999). This keeps the Institute's focus on retaining customers for the *long term* by providing quality software, support and training.

SAS was in pharmaceutical use by 1974. If you're in corporate IT, ask yourself: "How many software products were used in 1974 and are not only *still* in use, but more *pervasively* at thousands of organizations in 130 countries?" How many are in current use by 95%+ of Fortune 500 companies and 90%+ of pharmaceutical companies? COBOL is widely used in the banking and insurance industries; its replacement with newer technologies may be cost-prohibitive. Further, if you pulled the plug on one, would it bring a company's (*industry's*) R&D to a grinding halt?

Best of Breed

Though SAS software once was IT's *dark horse*, it is emerging as *Best of Breed*. This results primarily through expansion of the suite's functional breadth and depth. Rather than just *statistical* tools, SAS now provides complete business solutions; examples include collaborative business intelligence (CBI), customer relationship management (CRM), PharmaHealth Technologies™, Balanced Scorecard (BSC), CFO Vision™, HR Vision™, and IT ServiceVision®.

SAS software has not just become prevalent, but rather a (pharmaceutical) industry *standard*. This is evidenced by the FDA's selection of SAS transport files as an accepted standard for receiving and archiving datasets. Additionally, the SAS System Viewer is a key tool used by the agency to view SAS transport files and data sets.

SAS provides MultiVendor Architecture (platform independence) and MultiEngine Architecture™ (data structure independence), backward compatibility, and the ability to easily switch between batch and interactive modes. SI also evolved existing software in response to users' needs and rapidly responded to industry changes in hardware and O/S. These steps ensure *future viability*, which are critical to support of applications under (future) development.

A key advantage of SAS tools is that they are *task-focused*. SAS/IntrNet™ enables cross-platform full product web-enablement. AppDev Studio™ permits JAVA web-application development. JMP® enables data exploration and presentation. Enterprise Miner™ provides knowledge discovery through data

mining for unknown relationships and hypothesis testing. SAS/Warehouse Administrator™ permits data warehouse access among integrated products. IT Service Vision reveals system performance metrics. In contrast to business and development applications fallen by the wayside, SAS tools rest on an integrated architecture for forward-thinking technology.

Essential to tool effectiveness is applicability to the business. The SAS product suite contains *business-focused* tools for information delivery. The PharmaHealth Technology Process™ standardizes pharmaceutical research practices into a repeatable framework. SAS/Access® to R/3 enables access to key enterprise resource planning data for analysis of enterprise-wide data. CFO Vision provides enterprise financial management solutions; HR Vision™ facilitates human resources strategy and decision support.

SI's effectiveness is borne out by their partnership with other shapers of leading industry trends. Among many others, SI is currently partnering with IBM, Sun Microsystems, Oracle and leaders in several industries. Competitive advantage requires rapid formation of sound inferences for strategic information delivery. Those recognizing sound technology return on investment (ROI) will lead the future.

Changing Perceptions

Given that SAS is Best of Breed, why is it not better known (understood) in corporate IT? Answers to a few questions make this clear.

Question 1: How many staff in your IT organization have a scientific or applied academic background? An answer of 'very few' or 'none' decreases the probability that anyone in the IT organization has *experience* with the SAS system.

Question 2: What is the likelihood that staff with a scientific background will advance into leadership positions in your IT organization, relative to those with computer science, business or engineering backgrounds? Again, an answer of 'very few' or 'none' not only decreases the probability of SAS familiarity, but also decreases the likelihood of executive management's *awareness* of the power of SAS tools.

Question 3: If your organization's R&D unit has historically supported its SAS use, then *who* is informing corporate IT about new features in the SAS system?

Candid response to these questions leads to the core of limitations in use of SAS tools by organizations. SAS has historically been used among (mathematical) scientists and, more recently, quality analysts. As the tool suite has grown, there has been a lag in new tool adoption, even among existing users.

The 'old' SAS community of researchers only slightly overlaps the 'new' community in IT. The latter has been slow to alter its perception of SAS as a tool for 'people who crunch numbers'. How can this be overcome to enable organizations to more fully leverage the power of SAS software?

Metanoia

What is called for is truly a "shift of mind." The term describing this is *metanoia*. Senge (1990) uses this expression to describe what happens in "learning organizations." He notes that, when asked what being part of a great team is like, people identify as the prominent feature the *meaningfulness* of the experience. Those who've been there, whether in business, sports, or other endeavors, acknowledge a feeling of "being part of something larger than themselves, of being connected and generative"; they frequently spend the remainder of their lives searching for a way to recapture that spirit.

The reality is that organizations spend the majority of their time in "survival" or "adaptive" learning mode. While essential, this mode is insufficient to expand an organization's capacity to create its own future. To become able to do something not previously possible requires 'generative' learning – the capacity to create.

Senge maintains there are five dimensions (disciplines) within innovative learning organizations:

- Personal Mastery
- Mental Models
- Building Shared Vision
- Team Learning
- Systems Thinking

Personal Mastery

Personal Mastery is the achievement of a heightened level of proficiency. He notes that people at this level "are able to consistently realize the results that matter most to them – in effect, they approach their life as an artist would approach a work of art." They begin by clarifying the things that matter most to them and live in service to their highest aspirations.

Mental Models

Mental models "are deeply ingrained assumptions, generalizations, or even pictures or images that influence how we understand the world and how we take action". Working with (our own) mental models requires understanding internal pictures of the world and subjecting them to rigorous scrutiny. It is important to engage in "conversations that balance inquiry and advocacy, where people expose their own thinking effectively and make that thinking open to the influence of others."

Incorrect mental models are essentially what Shapiro (1991) attributes to eight deadly assumptions leading to a pattern of poor decisions in organizations:

- we act on the facts
- we know what the facts are
- we have all the facts we need
- we know how to win in our business
- of course we know what our product is
- we know how to make a buck
- we understand what our people want
- our people know what to do

Individuals making these assumptions with a misplaced confidence in them are susceptible to a pattern of poor decisions. The pattern of poor decisions will remain unaltered until incorrect 'truths' are addressed. Shapiro states "the key is

organizational learning, which allows current assumptions to be modified and thereby creates the willingness for change. In practice, learning of this sort requires critical review and challenge, and few people are able to sincerely challenge what they already know to be true."

Team Learning
When teams are in a "team learning" mode, they not only produce exceptional results, but team members grow and learn faster than they otherwise would. The key to team learning is dialogue, which differs from discussion and debate as follows:

Dialogue	-an exchange of ideas and opinions
Discussion	-consideration of a question in open debate
Debate	-contention by words or arguments

Note the difference in their definitions. Clearly, discussion and debate are *adversarial*, whereas dialogue is an *allied* activity. Senge observes that teams engaging in dialogue suspend assumptions and discover insights not attainable individually. In organizations, teams must achieve this state since they, not individuals, are the fundamental learning unit – if the team does not learn, the organization does not learn. That teams, rather than individuals, are the fundamental learning unit seems paradoxical. Yet, examples in learning organizations reveal that team intelligence exceeds the intelligence of individuals on the team; such teams "develop extraordinary capacities for coordinated action."

Tiggeman and Sabel (1997) suggest this in asserting "the mechanisms by which learning can reduce time are numerous, and include factors such as process standardization, improved scheduling, work efficiency enhancement, fewer study layout changes, more effective data processing, and so forth. Learning is often the cumulative result of many small improvements rather than major breakthroughs and tends to vary depending on the amount of management attention devoted to capturing it."

Shared Vision
Building a shared vision is important, since organizations rarely achieve significant levels without deeply shared goals, values and missions. People must be drawn together around a common identity and sense of destiny. As Senge notes, "when there is a genuine vision (as opposed to the all-too-familiar 'vision statement'), people excel and learn, not because they are told to, but because they *want* to". He states that "given a choice, most people opt for pursuing a lofty goal, not only in times of crisis but at all times."

Systems Thinking
"Systems thinking is a conceptual framework, a body of knowledge and tools that has been developed over the past fifty years to make the full patterns clearer and to help us see how to change them effectively," according to Senge. "Instead, we tend to focus on snapshots of isolated parts of the system, and wonder why our deepest problems never seem to get solved."

"Building learning organizations involves developing people who learn to see as systems thinkers see, who develop their own personal mastery, and who learn how to surface and re-surface mental models, collaboratively," according to Senge.

Systems thinking can even be extended to cover organizational structure. Drucker (1973) notes that a systems structure of organizational design arose out of one apparently unique (at the time) management problem – the American space effort in the 1960's.

Drucker states "it is becoming clear that something very much like the systems structure will have to be developed for the multinational corporation. Indeed, many of the approaches worked out for the multinational corporation are truly (though not consciously) systems management concepts." He notes that "the requirements for a systems structure to work at all are exceedingly stringent. It demands absolute clarity of objectives. The objectives themselves may change, and change rapidly. But at any one time they must be clear. And the objective for the work of each of the members of the system must be derived from the objective of the whole and directly related to it. In other words, the systems structure can function only if the job of thinking through 'what is our business and what should it be' is taken seriously and performed with excellence. And then it requires that operational objectives and strategy be developed with great care from the basic mission and purpose."

Communications are critical in the systems structure. Notes Drucker, "Another requirement is a demand for universal communications responsibility. Every member of the systems structure, but especially every member of every one of the managing groups, has to make sure that mission, objective, and strategies are fully understood by everyone, and that the doubts, questions, and ideas of every member are heard, listened to, respected, thought through, understood, and resolved." The communications requirements should not be underestimated, according to Sayles and Chandler (1971); they note that "the communications requirements in these projects (i.e., NASA) are overwhelming compared to those of more traditional manufacturing processes. The impact of a newly identified problem or discovery, or the search for the source of an unexplained difficulty demands that a number of people in a variety of organizations be involved almost simultaneously." Case in point: the Challenger space shuttle disaster, caused by a known technical limitation, could have been averted if a warning issued by technical staff had successfully been communicated to those making the launch decision (Leighton and Feynman, 1992).

A final requirement relates to the responsibilities of team members. Drucker states "A third requirement is that each member of the team, i.e., each managerial unit, take responsibility far beyond its own assignment. Each member must, in effect, take top-management responsibility. To get any results, requires from each member, a 'high order or responsible autonomy and the opportunity to innovate and even to change plans.' At the same time, each member must make efforts to know what goes on throughout the entire system."

Sense of Urgency
"I believe this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to earth." -John F. Kennedy, 5/25/61.

"That's one small step for man, one giant leap for mankind." Neil Armstrong, 7/20/69.

Elapsed time between the Kennedy and Armstrong statements: *Eight years, one month, twenty-five days.*

Average drug development time for drugs approved 1990-96: *Fourteen years, eleven months.*
(Pharmaceutical Research and Manufacturers Association of America, 1999).

Clearly, there should be a sense of urgency in the industry. As Maloff (1999) notes, "since most new drugs do not recover their cost of discovery, there is a compelling need to establish a faster route to market for the new drugs which sustain ongoing research and development (R&D) expenditures. A week's delay for a $500 million drug will incur a cost of $10 million at peak sales; that price is paid at peak sales, regardless of the point in the cycle – preclinical through product launch – at which the delay occurs. Using the same index, a one-hour conference call to clarify issues between a sponsor and one of its contract partners costs $60,000 in peak sales."

Drews and Ryser (1996) point out that the pharmaceutical industry is facing an innovation deficit. In their words, "the typical pharmaceutical company does not provide a research environment which is particularly conducive to originality, lateral thinking, and high productivity. Research must be free from distracting and counterproductive influences." They also note, "pharmaceutical research at its best means using *existing* technologies intelligently to achieve therapeutic results."

If SAS software is critically examined in light of its inherent powerfulness, many (perhaps even SI staff) would be surprised at the level to which currently licensed software is under-used. Pharmaceutical organizations often use only some of the SAS tools and solutions available. The failure to apply existing powerful technologies to business problems represents a serious shortcoming.

Basics of Integration

When one enlarges a one-room building into a larger structure, several logical steps are followed. These steps are analogous to those required to integrate SAS in corporate IT.

First, *reinforce* the pre-existing foundation to ensure the original room will not collapse during construction of the expansion. In IT, this means providing superior support to the user base
(typically scientific users). If possible, relocate support to the IT organization so staff can display SAS software performance relative to other products (such as # jobs/day and how little downtime is). From within the IT organization, enlighten IT staff to the crucial role SAS tools play in a regulated environment and how they fulfill GxP requirements.

Second, lay the groundwork, then pour the concrete on which the building will rest. This means taking steps to eliminate barriers to widespread use, such as restrictions on geographic limitations in licensing, especially in global organizations. Try *lowering unit costs* to get the most material (software) for the lowest cost.

Third, carefully install the floors and raise walls of the addition. Since everything else rests on these components, make sure the first few "non-scientific" applications are *successes in critical areas* (such as manufacturing, marketing, human resources, or finance) other than R&D.

Once the shell of the building is up, then its time to tie on the roof. In order to advocate SAS use in non-traditional arenas, it is essential to:

1) Understand the organization's current technology architecture. This involves recognition of present technology solutions given business information delivery needs. Witness the difficulty facing the insurance industry in justifying mainframe COBOL upgrades. Pervasive use of this hardware/software combination provides solutions to a relatively static set of business needs. In contrast, the pharmaceutical and aerospace industries have very different business (hence technology) drivers. Differing business needs drive different technology choices.

2) Determine the "Goodness of Fit" of existing architecture. This involves assessing the business gain (ROI) accruing from software adoption. Recognizing the value of IT to business success, leading industries acknowledged the value of Enterprise Resource Planning (ERP) and Y2K readiness then committed billions to their implementation. This conclusion should be reached regarding the value of information delivery by adopting proven tools. Anderson (1996) observes "an investment of several hundred thousand dollars compared to the millions in value added from faster development time, earlier market launch and sales, longer patent coverage and an improved competitive advantage, is not only justified but wise."

3) Recognize Tool Applicability.
Through *ad hoc* statistical use, SAS software has unfairly become identified with 'cowboy coding'; while 4GL capabilities permit this, its *architectural integrity* lends it to *sound systems design* (Burger and Pochon 1997, Burger et al. 1999), *validation* (Pochon and Burger 1998) and *analyses* (Burger et al. 2000). Corporate IT's unfamiliarity with this capability and a failure to objectively examine assumptions may render them unable to adopt it for widespread organizational implementation.

4) Choose candidates for adoption wisely.
Select the tool suite best suited to business needs with an eye toward integrated strategic information delivery. This requires appropriately mating specific tools to business needs while ensuring compatibility across very different business areas. Avoid "overkill" with technology. In many cases, a distinct but robust tool (like JMP) with a fast learning curve is really the appropriate technology solution.

In some organizations, non-traditional candidates for SAS tool use can be pursued proactively whereas in other organizations waiting for an opportunity to arise is most sensible. In fast-paced, cutting-edge organizations, a presentation to leadership may result in a green light through rapid buy-in. In conservative organizations, it may be best to wait for the planets to align. This often consists of a crucial business need in a critical business unit coupled with executive sponsorship

and a leadership willing to conduct a serious and objective review of available tools.

The remaining "infrastructure" -- analogous to wiring, plumbing, doors, windows, appliances and other components of building -- must be put in place.

Business Knowledge: Intimate business knowledge ensures priorities and business needs are well understood (Figure 1). In a complex industry, it is essential in selecting the best tools for information delivery to ensure they fulfill business needs and provide a ROI. In a custom-built house, kitchen layouts and home offices would not be constructed without substantial knowledge of what the primary user in each area wants.

Business Integration: Tools must be tightly coupled to business needs and integrated with one another to ensure sound decision making and cost-containment.

Technology Framework: Organizational standardization is essential for universal information access, uniform solutions and consistent interpretation.

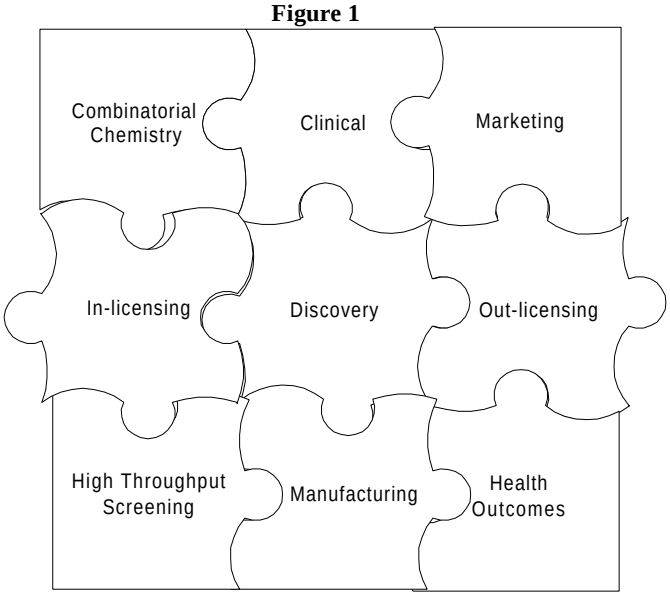
Architecture: The role of an architect is essential to ensure optimal tool implementation for effective IT business solutions.

IT Expertise: Involvement of IT experts is necessary to ensure technologies are applied most effectively across the range of business needs throughout the enterprise.

Cross-Disciplinary: Expertise in multiple disciplines ensures sound inference formation and provides reliable enterprise-wide information delivery.

Collaboration: Cross-functional cooperation is essential to implement consistent and effective enterprise-wide solutions.

Figure 1



Customer Service
Rapid, effective in-house SAS support yields dramatic benefits (LaBore and Burger, 1999). Users frustrated with software due to technical problems decrease its effectiveness at least two ways: first, they may never fully realize the power of the software as it applies to their business problem and, second, through negative feedback they can squelch both support and adoption of the software by others. In-house technical support should provide user assistance in a way that fosters technical independence. Explaining steps to users (such as online searching of SAS Notes, doing a search of the SAS-L archives, checking the Master Index of SAS publications, etc.) helps them begin solving problems on their own.

Advocacy
To establish enterprise-wide solutions, it is essential to cross organizational lines in building advocacy among business units. This requires skill in both identifying business problems and persistence in seeking solutions.

Advocacy must also be built across IT/customer lines through consistent delivery of timely business solutions. This builds advocacy in *both* IT management and business unit management by establishing trust and credibility through a reliable track record.

Management Sponsorship
Within an organization's corporate culture, there may be reluctance to deviate from traditional uses of certain software for business solutions. However, great strides in product acceptance occur when motivated individuals sponsor or champion product use from *both* IT and end-user perspectives.

Since word-of-mouth is critical, the value of *influence* as provided by opinion leaders in an organization cannot be overstated. However, limited benefit results from exposure of leaders to useful technology, unless the technology is shown to be consistent with the needs, attitudes and beliefs of the individual. Thus, successful adoption of SAS is more likely to occur when those driving the process focus their efforts on leaders who recognize and champion the benefit in the application of technology.

Tiggeman and Sabel (1997), observe that "people will follow leaders who inspire a vision, challenge the process, model the way, enable others to act, encourage the heart, and thus have competent professionals focused on shared success."

Quality
There is no question that accelerating the development of safe and effective treatments for disease will benefit everyone. As Clemento (1999) notes, "Pharmaceutical companies will achieve an acceptable return for stockholders; regulatory agencies will better fulfill their mandated purpose; and, most of all, patients will have the benefit of new and better therapies in a timely manner." However, a caveat is that we must *never* substitute speed for quality. Clemento cautions that "accelerated development does not imply recklessness. Development programs that are not founded on the principles of quality and rigor are destined for delay, at best, and failure, at worst. Quality, and not just regulatory compliance, must permeate every element of drug development. Understanding of, and adherence to, the spirit and principles of good manufacturing practice, good laboratory practice, and good clinical practice are imperative."

Summary

SAS software clearly provides powerful information delivery and enhances productivity. However, there is limited awareness in corporate IT of its role in knowledge formation within organizations, particularly in non-traditional areas. SAS provides complete business solutions (CBI, CRM, PharmaHealth Technologies, BSC, CFO Vision, HR Vision, IT Service Vision) in addition to being a Best of Breed software suite that has outstanding functional breadth and depth. The products are both task-focused and business-focused, and are a pharmaceutical industry standard.

Too often, unfamiliarity of SAS capabilities among IT professionals leads to selection of software that duplicates capabilities already available in current SAS installations. A shift of mind must occur in IT organizations to embrace the information delivery revolution underway. Once this occurs, SAS software is well positioned to accelerate pharmaceutical product development, becoming more important in a life-saving process.

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