I. Introduction

The company for whom we work is a small but growing biotechnology company. In the past four years we have grown from 50 to 160 employees, and revenues have grown from $1 million to $35 million. But the staffing of individual departments, particularly the clinical data management department, has not always kept pace with the company’s growth rate. In January 1991, for example, the data management department supported two small clinical trials with one director, one data entry operator and one programmer. Today, we support thirty-five trials with one data entry operator and two programmers.

A small company often bears little resemblance to the large pharmaceutical companies that the public perceives as its peer group. We simply do not have the staff or the budget to carry out projects, systems, and procedures that are often considered mandatory to someone whose professional frame of reference is a large or even a medium-sized pharmaceutical company. We have often been amused in conversation with our larger peers when someone suggests that we “have our systems people” do something, as if such resources exist.

The demands of a small-company environment are unique. We must meet the same stringent regulatory requirements as our larger cousins. Sometimes the lack of resources means that we must adjust our expectations and, more to the point, those of our management. But someone can inadvertently stifle the company by accepting these limitations too willingly, too rashly. If we were to assume that we cannot have the benefits of a large company system, without asking whether there is a way to compensate with small-company agility and efficiency, then we might short-change our potential.

So the directive is this: do as much as possible with as little as possible. And with the scrutiny that health care reform focuses on the process of new drug development, it is likely that larger companies, who perhaps once had more generous budgets, are increasingly adopting the same directive and coming to resemble smaller companies in their management of resources.

We feel that our sales-per-data management employee ratio is evidence that we are doing something right. This paper is about the role SAS® software can play in meeting the challenges of a small-company environment. Each of us probably has the common experience of justifying what management considers being the high cost of SAS software. Our drug shipment application, one of several FRAME applications that we have developed and implemented over the last ten months, illustrates the dramatic efficiency gains that can be made from within the SAS software environment. Using this application as an example, we can point to the expenditures that have not been made (more people) and products that we did not have to buy (Oracle®, Powerbuilder, etc.). To explain our point, we are going to review:

- A business process as it existed when data management inherited it.
- The same business process after we brought the resources of an object-oriented application to bear upon it.

II. Here is How We Used to Do It

In clinical research, a company constantly moves supplies of an investigational drug from the manufacturing environment out to the various clinics, usually dispersed throughout the US or beyond, where doctors will treat patients who need new therapies. In some ways, the manufacturing idea of “just-in-time” is relevant: for business and ethical reasons it is unacceptable to delay a patient’s treatment in, say, Boston because the company failed adequately to supply that site. On the other hand, short shelf life and limited supply makes it impossible to overstock several different sites. Clinical supplies lost to expiration can make the cost of clinical trials balloon if the process is not managed well. When we inherited the responsibility for managing clinical supplies, it consisted of the following tasks:

- Someone in a clinic would call or fax us to inform us that they were low on or out of our product. Since they often would not initiate such a request until the need was immediate, the request would immediately put us into a crisis mode requiring urgent response. In
In 1991 there were approximately five crises per week. By the end of 1993, thirty or forty urgent shipments a week had become common. The business of supplying clinical sites with our products had become an almost full-time job for the Clinical Research Administrator.

- The administrator would word-process a Request Form documenting the shipment for regulatory purposes and notifying people outside the department to act (see Figure 1). Ninety percent of the information on this form was either predictable (today's date as the date of the request) or repetitive (protocol number, site address, etc.), yet it took almost six years before someone realized that such constantly accessed information is best maintained in a database and not in a word-processed list.

The problems with this system were that it demanded too much time from the administrator and the programmers and was inappropriately dependent upon word-processing. Data management resources were applied only late in the process. The result was that treatment was scheduled around shipments, rather than the other way around. And we considered it ethically unacceptable to expect AIDS patients to delay treatment for advanced opportunistic infections because of our inefficiency.

III. Here is How We Do It Now

In recent months, a reorganization within our department placed this task under the management of a Director who was responsible for both clinical research and data management. Suddenly, the administrator who was doing this work (by now, almost a full-time job as the clinical program flourished) and the SAS software programmers who understood the power of the SAS System and who were among the first to get formal training in the new FRAME technology, were peers, observing each other, working in the same technical and physical environment. The new FRAME entry applications make data processing features accessible to non-technical administrators by allowing mouse-driven selection from pop-up lists and by using SCL to perform many functions behind the scenes instead of forcing people to execute repetitive tasks. The steps now consist of the following:

- The administrator would then copy the two paper forms for distribution.
- One copy of the shipment request would go to data management, which would key the data into a SAS software data set that stored one observation per shipment. Because SAS software was only accessible to programmers at that time, programmers were doing the data entry. As the number of shipments grew, data entry would be done in batch once a month as time would allow; thus the data record was never really current.
- Further data were entered into this data set as new information became known.

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- From a main menu, the administrator pulls up a Request Screen (see Figure 3), which presents her with 8 fields, 5 of which are filled with data from selection lists. These lists are generated using SCL lists created from the SAS software data sets that hold current information on the companies clinical trials. This gain in efficiency and accuracy is augmented by the fact that the system automatically fills fields when the data are predictable (today's date) or estimated (the number of vials). This screen was designed to rely totally on
mouse-driven input: our goal was to use the minimum number of clicks, and nothing but clicks, to complete the screen. The resulting advantage: no data entry errors and increased currency of the data sets tracking clinical research. This screen also reduces data redundancy.

Figure 3: SAS/AF Request Screen using FRAME

- When the user deems the request to be complete, the SCL uses stored SAS/GRAPH® code to draw the two forms that were formerly word-processed (see Figures 4 and 5). Such a process eliminates the need to design business forms in another product such as PageMaker, and the need to print and store supplies of multiple forms. Again, a certain level of data integrity can be assumed, since data are not being entered more than once.

Figure 4: SAS/GRAPH Shipment Form

- The last module of the SCL writes an observation to the shipment data set, eliminating the data entry step that had, over time, become so cumbersome.

This system is so simple that virtually anyone can use it. When the Clinical Research Administrator is out of the office, a minimally trained file clerk can keep clinical supplies moving.

This new system does require prompt maintenance of all the associated data sets in our Research Administration System (protocols, drugs, sites, staff, etc.). The administrator was doing this work anyway in a word-processing environment. Since the data sets are accessed through FRAME entries, the transition from word-processed lists to data sets is not difficult. Moreover, we could delegate the responsibility to maintaining these shipping-related data sets out of data management and into the hands of clinical people who most need the data, for example, people with direct contact with the sites.

We also used the data to place an EIS object that graphically presents information about current and historical shipping data to anyone with access to our EIS. The Executive Vice President of Medical Affairs and the CEO have a quick, visual way to monitor the growth of the clinical program over time and to assess the impact of clinical supplies on the department's budget.

The new system results in more appropriate use of resources, because programmers are now programming rather than maintaining data sets, administrators have their jobs enriched and streamlined, managers are managing, and the data are now maintained by people who have the first access to new information. All of our previous SAS software training in SAS/GRAPH, SAS/AF, and Screen Control Language has been leveraged. We did not need to
disperse our efforts by incorporating other products and we can maintain a streamlined, simple technical environment for high performance.

Another gain is data integrity: instead of a protocol number being entered at multiple points, it is entered and maintained as a single point, which then provides the data for the selection lists when they are needed for cross-reference.

We would like to stress an issue separate from the FRAME technology but equally important in terms of leveraging resources. The ANNOTATE option of SAS/GRAPH is underestimated. There is almost no form that cannot be created in SAS/GRAPH, eliminating the need for other products and training. When we designed this application, one of our goals was to avoid forcing the users to work with different forms. We think we have been successful at recreating the forms that were once produced in PageMaker.

Finally, the whole process is no longer passive. We do not need to wait for the site to contact us requesting shipment of our drugs. By analyzing enrollment rates and historical shipment records, we can forecast drug shipments with enough precision to satisfy the "just-in-time" need to supply the clinical sites.

IV. Here is How SAS Institute Helped

SAS Institute has enviable product development. Just about the time when we figure out that we need something, it turns out that Institute has been working on it. Their training is excellent. Moreover, there is further support available on an ad-hoc basis. When the sophistication of an application warranted it, we invited Bill Powers, a SAS Institute trainer and consultant, to spend two days at our company reviewing our applications. By the time he left, we felt that the state of the FRAME-based data entry systems was efficient and effective. And we now have someone in the SAS Institute organization who knows our projects and our capabilities who we consider to be our partner in our applications development.

Many pharmaceutical companies limit the role of SAS software to statistical analysis. It has much to offer, particularly with the portability of applications across platforms as a company’s technical environment evolves. General business processes can be streamlined and made efficient by incorporating object-oriented applications. We have a long list of processes that we would like be able to improve with FRAME applications, and our only limit is time.