

## **Case Study for ABRF 2012**

### **Stephen A. Bobin**

#### **Background**

The University of Southern Antarctica is situated on a 50 acre campus two miles south and west of the South Pole. The University has a 5,000 student undergraduate College, a Business School, Engineering School and a Medical School. Associated with the University is a 100-bed teaching hospital and two research outposts owned by pharmaceutical companies. The schools, hospital, and research outposts are connected by a series of ice tunnels.

The Medical School graduates 50 Medical Doctors a year and has a current total of 190 medical students. There are 500 graduate students in 200 laboratories in the Medical School actively pursuing a PhD. There are 237 funded investigators in the College and the Medical School in 5 departments. The Engineering School has 10 students pursuing a PhD in biomedical engineering who are associated with various labs in the Medical School.

On a 2005 vacation to the North Pole the chairman of the Molecular and Cellular Biology department, visited the DNA Sequencing Facility at the Institute for Basic Research in Krill Biology and was amazed at the advances in technology since her last vacation in 1992. The Chairman returned to USA determined to have a capillary DNA sequencing instrument within one year.

The Chairman assembled a committee of her biggest supporters and wrote a near perfect S10 grant for a new IBA 1111(Eleven eleven). The grant was funded beginning in March of 2006. At that time all DNA sequencing work was being done in individual laboratories or being set to Korea via dog sled and supply barge or at slightly higher expense by rocket. The turn around time was three to five weeks.

#### **The new venture**

The committee had agreed to house the instrument in the Chairman's laboratory. After the Chairman discussed operating costs with Jack Frost, the local IBA representative, the Chairman decided to place the instrument in a Core Facility to allow him to recover operating costs in compliance with university regulations. The Chairman felt the S-B facility was over staffed and in need of an additional source of revenue. The Core Facility was originally organized as a university cost center to supply Snark blood for the culture of Wiggly Worms. However, funding for Wiggly Worm research had fallen off since the discovery of a new species, the Wigglier Worm that could be grown in grapefruit juice.

The S-B Facility Manager is Doris Doolittle, a Ph.D. level scientist. She supervises one technician, Naste Neat, a tech with fourteen years experience. Doris' main job was Snark hunting and Naste did the bleeds.

Snarks lived in the ice tunnel network and were easily captured by charming them “with smiles and soap”. They had a large vein on the tip of their nose from which Naste was able to withdraw several 10 cc tubes of blood. After the bleed, the Snarks were bandaged, given a bar of soap, and released back into the tunnels. Three hours a day were dedicated to the Snarks and blood samples. The remaining time Doris and Naste did a little book keeping, net surfing and applying for jobs they thought would be more satisfying; but they secretly feared that the work would be harder. The Chairman decided it was best to shut down the Snark Blood Business and give them something else to do.

### **Equipment Purchase**

In March of 2010, the Chairman delegated the responsibility of purchasing the instrument and arranging set up and training to Doris.. Doris delegated to the purchasing agent, Nato Brite. Nato had previously worked for an oil company making bulk purchases of oil collected from the Gulf Stream off the shore of New Jersey. Nato saw the \$200,000 S10 award as an opportunity to show off his purchasing skills and began negotiating with IBA. In July of 2010, negotiations with IBA were completed; Nato had a deal. For a relatively small additional sum, he was able to get a two-year supply of consumables at a significant discount. He passed up the opportunity to pre-purchase 2 years of service agreements at two thirds of the asking price. Because he had done that with his electric toothbrush that never broke, he felt he had been robbed. He arranged to have the consumables delivered with the instrument, fearing the deal would be forgotten over time. Unfortunately, neither Doris or Nato were receptive to the IBA reps’ information about a major technology upgrade to the IBA1212, a technology that doubled the 1111 capacity, shortened the turnaround time, produced higher quality data and was slightly less expensive to purchase and operate. They would have had to wait until October of 2010 for shipment of the 1212 and they were under pressure to get up and running.

### **Setup and Training**

The instrument and reagents were delivered in September of 2010. The IBA service tech tried numerous times to set up an appointment for an installation and preliminary training but ran into problems with weather, Doris’ vacation, and Naste’s hockey schedule. The instrument was finally installed in late November, 2010. IBA offered a week long training course as part of the instrument purchase. Neither Doris nor Naste were willing to travel to Seattle, WA, to take the course, so they opted to have onsite training at a considerable extra cost. The training was scheduled for late December, 2010. Just prior to the arrival of the training technician, Doris realized that she and Naste had never performed the procedures that the service technician had advised would familiarize them with the instrument. The training was put off until after Christmas break. By the end of January, Doris and Naste were trained and had run real world samples made by them from material received from the Chairman and a few others. On February 1, the Chairman held an opening ceremony and invited IBA representatives to give

a short program on sample preparation, the use of the instrument and data analysis. Two Associate Professors, a Post-Doc and ten graduate students attended, primarily to sample the free food.

### **The Early Stages**

Open for business on February 2, Doris and Naste prepared for an onslaught of samples. By the end of the week, it became clear that it would take a while to reach the volume of business the Chairman had predicted. In addition, the data were poor because the samples they did receive were of poor quality and they rapidly tired of explaining that to the customers.

As time went on, business picked up. The customers who provided good samples got good results. Those who, like the Chairman, let the lab prepare their samples, were satisfied.

After two months Doris, decided to do some billing. To arrive at a per sample rate, Doris had done a lot of surfing and came up with what she judged to be the going price for the service. She wrote invoices, billing for samples that she had recorded in what she called her logbook, a stack of paper towels she kept behind her computer. She knew that the “registered” samples were less than the total they had processed, but she figured that she would have a easy time collecting from only the investigators who were happy with the lab’s work. For the most part, this was successful, so she decided to turn away customers who provided bad samples and just deal with her best customers.

### **Pressure from Above**

Things were going along just fine, according to Doris, when it was discovered that the charge backs from the business were falling short of expenses by about 90%. Narley Numbers from Finance called Doris and asked if there would be funds to cover the costs. Doris made an appointment to see the Chairman to ask for funds to cover the deficit. He asked how much it was and what would be the on going expenses until the end of the fiscal year. Doris had no idea. She went back to the lab and a week later had these numbers to show.

### Doris cost calculations

Catagory	Current FY	Next FY	
N-Salary+Benifits	20	22	
D-Salary+Benifits	15*	32	
Supplies	10	12	
Reagents	15	15	
Proprietary reagents	30	30	
Total	90	111	
Number of samples	10	11	
Price per sample	\$9.00	\$10.00	

\* ½ paid by department

### What is the True Cost

Doris asks labs doing their own Sequencing to calculate cost also. Charlie in one of the bigger labs calculates, Doris does a correct cost analysis. Word gets out and Doris has 10 new customers.

#### Charlie's Calculation

Supplies	\$1.50
Reagents	\$0.50
Cost per sample	\$2.00

#### Doris Calculation

Supplies	\$ 1.50
Reagents	\$ 0.50
Salary	\$12.00
Disposal	\$ 2.00
Cost per sample	\$16.00

### We need more Users

Doris decided that the reason they had so few customers was her price was too high. She goes to the Chairman and asks her for help. As it turned out the Chairman had some money in the departmental account that needed to be spent. She suggested that she award a lump sum to investigators that can only be used in the Core facility. Once word gets out there is an unprecedented jump in the

core's business by 20%. Doris was once again overwhelmed. She knew the instrument had the capacity to handle the samples but preparing the samples became a roadblock. She and Naste just could not keep up with the instrument even when they extended their shifts. Doris argued that adding a technician would actually lower costs.

**Doris cost calculations**

Catagory	Current FY	Next FY	Next FY+ stimulus
N-Salary+Benifits	40	42	42
D-Salary+Benifits	25*	52	52
T- Salary+Benifits			38
Supplies	30	30	30
Reagents	20	20	20
Proprietary reagents	50	50	50
Total	165	194	232
Number of samples	10	10	12
Price per sample	\$16.50	\$19.40	\$19.33

\* 1/2 paid by department

**Who do we hire?**

Due to the increased business, Doris decides she needs more hands. This way she can put on a second shift and decrease her turnaround time considerably. Doris works with Human Resources and creates a job description. Ads go out and CVs start coming in. After a month, she meets with the HR person in charge of her section to discuss the hire. There are ten CVs. They narrow that field simply based on whether or not the candidate has a science degree. She has two Biology Bachelors and a Chemistry PhD and the University president's husband. One of the Biology Bachelors and the Chemist are local, and are at USA because a spouse or significant other, who had landed a great job in university administration, brought them there. This would also include the president's husband with a Master's in computer science. Doris discusses bringing the fourth candidate in for an interview. HR thinks she should interview the three local candidates first.

Doris has little experience interviewing job candidates and asked for some instruction from HR.

Doris interviews the president's husband first to get him out of the way. He is a Masters level programmer and claims he wants to move into Bioinformatics someday. He thinks a job in a DNA lab is one way to gain some appropriate knowledge and experience. Doris is annoyed from the start that she is forced to consider this guy, and decides she will not hire him, ever.

The Chemist seems like a good catch to Doris. He did his PhD in synthetic organic chemistry. He sees his future in biochemistry or molecular biology and says he wants some basic lab experience. He is willing to work for the offered salary, an hourly technician's salary of \$12-\$15 an hour.

The local Biology Bachelors is the wife of a medical student. She switched majors from Art History to Biology in her junior year to take classes with her husband. She has never worked in a laboratory. Doris is a little concerned about her enthusiasm for laboratory work when she tells her that she hates to cook.

Doris decides to bring in the second Biology Bachelors at university expense. His CV shows he had several years of Laboratory experience early in his career. He subsequently moved to a job in the financial sector. After that, he spent the last couple of years in low-level technician jobs in Wyoming and Switzerland. She is concerned about hiring someone who has never lived in the ice caves and asks if this will be a problem. He replies that he has no worries and has already started looking for a cave of his own.

Doris does due diligence and contacts the two most recent references the candidates gave her. They all check out with no problems reported by the former employers. She informs HR that she is ready to make a decision. HR is too busy to meet with her and will proceed with the hire as soon as they know which candidate she wants to hire.

Doris decides to hire the male Biology Bachelors and move him from Korea at University expense. Her reasoning is with his experience in the financial sector she can hand her bookkeeping chores over to him, and he does have the most laboratory experience. He would be good with her customers because he is quite charming. He can start immediately.

Chuckie Maddoff started within two weeks and was happily learning the lab routine and loved being on the later shift alone in the laboratory. Doris showed him the books and had Narley Numbers teach him the university policies and what the compliance issues were. Chuckie loved this and was able to put the books in order in a matter of weeks, all the way back to the beginning of the fiscal year. He also took an interest in making sure that every sample processed was paid for and was willing to argue with customers who Doris would not bill because their samples were unsuccessful. He instituted a policy whereby a sample would not be run without a university account number. Doris figured he would pay for himself in no time. It was Chuckie's job in the lab to load 96 well

plates, do the extension reactions, and subsequent sample clean up. Doris and Naste observed him a few times and found that he was doing this job properly. They even bought him his own pipettor.

With Chuckie's presence, their sample backlog had cleared and they were running at about 75% capacity. The data looked as good or better than before and all was right with the world.

## **A Data Crisis**

Six months after Chuckie's hire, the read length on the standard dropped from 1000 bases to 950 bases seemingly over night. Other samples showed a similar problem and customers began to notice and ask questions. Doris began trouble shooting the problem by changing out the various reagents at random, thinking she would find the culprit quickly. This didn't help, so she called a service technician, thinking that the instrument was at fault. She claimed to have tried all of the things the service tech suggested, not exactly in the order the tech suggested, but she had tried them all. By this time, the instrument was off warranty. She decided to have the tech come out even if the travel cost to zone Z was \$10,000. The tech ran through the trouble shooting routine she discussed over the phone, and found nothing wrong with the instrument. She set up and ran samples overnight and found the reads were at 1000 bases. She suggested that the problem may be the lab's second hand thermocyclers. This came up when Naste reported that they had never had them calibrated. Doris was at wit's end. One day a couple of men in dark suits came to the lab with the Chairman and the head of campus security. They asked after Chuckie, who had not arrived at work yet. When he arrived he was put in hand cuffs and lead away by the men in the dark suits. It seems that HR failed to do a background check on Chuckie, as he was wanted for securities fraud by the SEC.

Some days later, when all of the excitement died down, Naste noticed that the problem with read length had stopped. Now Doris figured that Chuckie had done something to cause the problem, and now that he was gone, she didn't care what the exact problem was. Some weeks later, Doris had to take the late shift; she prepared and ran the samples as prescribed by her SOP. When Naste looked at the data the next morning, the problem had returned.

A week later, a student asked Naste if she could borrow a pipettor for a day or two while hers was being repaired. Naste gave her the new pipettor they had bought for Chuckie. She brought the pipettor back the next day and told Naste it was not working properly it was only delivering about half the set volume. Naste sent it and a couple of others out for calibration. The read length problem never returned.

## **A Seemingly Minor Incident**

On a tour with 3 new faculty hires, the Chairman suggested they stop by the S-B facility and meet the lab manager. The chairman was called away and left them at the door of the lab promising to return promptly. The group walked through the door, ignoring Doris (Doris was dressed in jeans she had had since she was seventeen and a Woodstock t-shirt that now read oodstoc); they introduced themselves to Naste asked him for a tour of the lab and a rundown on the services they provide. Thinking nothing about it, Naste showed them around and gave them the requested information. When they left, Naste shook his head, gave Doris a shrug, buttoned his lab coat, straightened his tie, and went about his business.

## **What's wrong with the data?**

Seventeen months had gone by since the instrument was installed. One day Doris was looking over a customer's data and noticed the read length was not as long as it might have been and the signal was weaker than expected. She looked at the standard and found the same problem. She looked back over three months' data and saw a slow deterioration in signal and some read length loss. Doris had been introduced to a Six-Sigma Black belt at a university party so she called him at the Engineering School and told him what she had observed. He came to the lab the next day, He and Doris went over the last six months' data. They graphed their finding, and saw a slow decline in the quality of the data over this period. They began a root cause analysis, and in a matter of an hour found that their reagent had reached its expiration date and was slowly losing strength. To prove this, Doris ordered a small quantity of new reagent and sure enough, results improved right away. She was still stuck with about a years' supply of expired reagent.

## **Replacing the new Technician**

With Chuckie gone, a work backlog was forming. That made Doris think she and Naste would have to start working two 12-hour shifts until the backlog cleared. She went to HR to inquire about reposting the original position that Chuckie had been hired on. HR suggested that she call back the rejected applicants to see if she might find one of them acceptable. The Physicist had picked up a job in the local off shore banking industry, and was making a six-digit salary calculating the odds on mortgage default swaps. The young woman was pregnant and in her 7<sup>th</sup> month. She declined the offer saying she will be returning to Argentina on the next barge out to deliver the baby. This left the President's husband who had in the interim opened his own website design firm. However, he was still interested. Doris was desperate and didn't want to go through the HR process again, so she hired Jack Cracker.



Jack turned out to be an excellent worker, he trained fast, and was easy to get along with. He was willing to learn anything and everything. Soon the lab was back up to speed, and the backlog cleared. He also wrote software for data distribution and a built a billing, sample tracking, and invoicing system.

**Forming a Team**

Doris was very happy with the way the lab was functioning. She decided to try some morale boosters to keep things functioning. She shut down the lab for two hours and took Jimmy and Naste out to lunch. Doris had been chatting with the Six-Sigma Black belt and he suggested that he come join them. During lunch the Black belt suggested they try dividing the labor in such a way that everyone does one part of the process. This way every part is easier to control and the person who was best at a particular process was always doing it. Jack was enthusiastic he said he could write a routine that would allow them to track sample flow and coordinate efforts. Naste suggested that the plan could work but worried about vacations and sick days. Doris thought it was a good suggestion she wanted to start immediately and asked the Black belt to help them set up the workflow.

**The Crisis**

The fiscal year ends, Narley Numbers calls Doris to task over her losses. Doris is shocked and dismayed and insists that her original rate calculation was correct. Narley disagrees and shows Doris her mistakes.

Doris vs. Narley Numbers cost calculations

Catagory	Doris	Narley
N-Salary+Benifits	42	
D-Salary+Benifits	52	
T- Salary+Benifits	38	
Supplies	30	
Reagents	20	
Proprietary reagents	50	
Total	232	
Number of samples	12	
Price per sample	\$19.33	

\* 1/2 paid by department