Application Note #7

Internal versus External Analytical Resources - What is Truly Effective?

Introduction

The outsourced laboratory market has been growing even through the last economic downturn[1]. Companies are required by regulation to test their products regardless of the economic conditions, environmental regulations are not suspended when the economy is bad and there is a stronger driver to understand product and process failures to cut costs and save money. As the business climate improves, many companies start to examine their external expenditures and wonder if it makes more sense to bring the capability in-house. Weighing the pros and cons and more importantly point out hidden costs may make this choice more complicated than originally thought.

Cost of outside services

Analytical testing and consulting companies have many models for pricing their products. At one end are the routine tests. The pricing is done as a cost per analysis. A quick Google® search brings up a number of laboratories that provide EPA tests on water. The prices of these analyses range from $100 to $200 per sample for organics. The methods are well-defined EPA protocols and multiple samples can be set up for analysis in an automated manner.

The other end is the consulting laboratory that prices their services on a per project basis. These projects are not routine, use sophisticated (and expensive) equipment and rely more on the knowledge of the scientist than the capabilities of the instrument. Here, programs start at a few thousand dollars.

For companies that use either of these services to examine their product, these charges can quickly add up over the course of a year. When management looks at the outside expenditures they begin to wonder if it makes more sense to purchase the equipment. But the price of the instrument is not the total cost of ownership.

Total Cost of Ownership

The total cost of ownership of an analytical instrument is an interesting question. The price of the instrument is usually the biggest number considered. Other factors, sometimes more important (and costly) are never examined. Using infrared analysis and the purchase of a simple FTIR as an example.

Purchasing an instrument

The price of the instrument is usually considered as the investment in a new technique. Most companies consider the return on this investment as the number to plug into their acquisition formula. For routine analysis, the price of an FTIR ranges from $15,000 to $20,000. But what does that get you?

Any instalment requires tools to manipulate and mount samples. These can be as simple as a holder for a liquid sample to accessories that are used for intractable samples. The trend in FTIR analysis is to use a technique called Attenuated Total Reflectance (ATR) where the accessories are typically between $2000 and $5000. So now the equipment cost is $17,000 to $25,000.

Staff

The next thing to consider is who does the analysis. If the company has no experience in chemical analysis, this requires a new hire. That brings recruitment considerations such as salary, benefits etc. Most bachelor level chemists have used FTIR in organic chemistry but a new chemist will not have much experience in the technique. Starting salaries for a new chemist average about $45,000". But with five years of experience the salary rises to $60,000. A master level chemist, who is more likely to have the background to take on this position with no technical direction, would have a starting salary of $65,000.

Rather than a new hire, a more likely scenario is that the company identifies some internal resource to become the expert. The identified staff member needs to become the expert in the instrument. That includes running the instrument and software and interpreting the data. At the $20,000 price point, training from an instrument vendor is an extra charge, running about $1500 for the first day and $1000 for each additional day. Training facilities are usually in a major metropolitan area so transportation and per diem costs have to be added. A two day training course with a list price of $2500 now has a total cost closer to $3500. If the identified staff member only has a passing knowledge of the technique then how do they become the go-to resource[9] Do they need to go to another training course geared to learning the technique[9]

Vendors and professional societies provide those courses either at a training center or in conjunction with meetings and shows. Again one can expect a cost for the course to be $ 1500 per day for tuition. Estimate another $3000 per course including per diem.

Looking at these numbers, training might be as low as $3000 but more likely closer to $7000. And these costs do not consider the impact of the staff member not doing the job they were originally hired to do.

Upkeep

Any instrument must be maintained. This could be in the form of a service contract or the organization could decide on a time and materials approach. Service contracts are typically 10%-15% of the purchase price of the instrument per year. A service contract may seem like a good idea since it will minimize down time. But increasingly, response times on contracts are tied to service levels. If you pay more the response time is faster. A contract typically includes preventative maintenance, consumable replacement and telephone support for hardware and software questions.

Consider the price of a service contract to be another $2000 per year. Typical instrument life is 10 years. So for our $20,000 instrument you could spend as much as $20,000 for a service contract. But as the instrument reaches the end of

life, vendors will refuse to put the instrument on a service contract.

The other end of the sen-ice and support spectrum is to contract for service on a time and materials basis. Here you are paying for the engineer's time, travel and parts. Let look at that part of the equation.

Engineer time is approximately $300 per hour. Companies also charge for travel, usually from a service center located in large metropolitan areas. If you are located in the area, you pay minimum travel (let's assume 2 hours) but there is also a minimum charge for T&M calls, usually 4 hours. So for the engineer to walk into your lab will be a minimum of $ 1500. And that does not include the parts.

Parts fall into two categories. There are consumables that need to be replaced over the life of the instrument. Parts like sources, lasers, desiccants and windows will need to be replaced regularly. These are considered consumables. Investigation of the average replacement price from a major FTIR vendor shows that one could expect an average part cost of around $ 1800/year to properly care for the instrument.

Replacement parts can get to be very expensive. Suppose you need to replace a beam splitter or a board. Probably expect at least $5000. When an instrument is new, failures occur under warranty. As the instrument ages, repairs build up. Assuming that the instrument performs with no problems for 5 years then needs service beyond a PM every 2 years we can expect approximately $3000 yearly for the last 5 years in service.

The one thing that we can count on is that the computer running your instrument will change. So now you need to purchase new software to support the new operating system on your new computer. Expect $2000 to $3000 for the software assuming that the instrument is new enough that the vendor has updated the software for the new operating system.

FTIR instruments, our example, don't usually require gas supplies or large amounts of solvents. These consumables would come into play for other pieces of equipment.

Data Interpretation

With any of the techniques that a company might bring in house, someone needs to know what to do with the data. For most analytical spectroscopy techniques particularly FTIR, spectra are identified by comparison to known materials, library searches or by interpretation from first principles. Let's look at these three approaches.

Compiling spectra of known materials in your process is time consuming. An hour of time per standard spectrum is a reasonable allocation of time. This is not only data acquisition but sample acquisition, documentation and disposal. So in a process with forty organic materials, the minimum is a week of time. This works in a situation where the potential contaminants are process related but what about samples that come from outside[9] Now the sources are infinite.

Purchasing libraries is a better solution but could be an investment of anywhere from a few thousand dollars to over

$20,000. Purchased libraries are stagnant. If the vendor adds compounds, you have to pay for the added capability. The other approach is a subscription service. Here you get all the new data but expect to pay in the neighborhood of $8000/year for unlimited access to libraries.

Finally not every item is in a library. Identifying a material by interpretation from first principles takes a skilled interpreter four to six hours on an average. For the less skilled analyst it could take days. And this is not a skill taught in college. Specialized courses are required and again can cost from $1000 to $3000.

Government regulations

If you are in a regulated field there are laboratory regulations and guidelines the analysis laboratory must comply with. Setting up the proper systems if none are in place can take valuable time. Under the Food and Drug Administration (FDA) Good Manufacturing/Laboratory Practices (GMP/GLP) it could take up to 2 months to put the proper systems in place for a new instrument. If the organization is unfamiliar with these procedures expect more time or the price of a consultant.

Converting to a service lab

Some managers approach the cost associated with an instrument acquisition by convincing senior management that *they* can go into the service business. The argument goes "We were spending XXXX with Company Y. If we start to sell the capability to the local businesses we can offset the price of the instrument." But this is dangerous for a variety of reasons.

Service labs are set up to propose the proper level of effort, price it to make a profit and most importantly deliver a quality product in a short turn-around time. This takes a very different mindset than a production geared analyst who is used to working on a number of problems and may not be required to deliver written results with quick turnaround.

Another downside is the liability. Service laboratories have contractual language limiting their liability. They also are skilled at separating one project from another to limit "cross-contamination". They have the skill set to interpret the data and present the interpretation is an appropriate manner. The Quality Control systems they have in place minimize the possibility of an incomplete or wrong answer that could have financial impact later.

Service labs are set up to respond to the occasional legal query or subpoena. Their staff is trained to testify in court, to limit the answers to the questions asked and to present the best "face" of the company. If the experience doe not exist to address these queries, responses can take days or weeks using up valuable resources.

Cost effectiveness of the purchase

Taking all the factors into account, the cost of a new instrument is not just the money given to the vendor for a new piece of equipment. The table below summarizes the costs as discussed above. Looking at averages, the real cost for purchase is close to $30,000 and the yearly average upkeep is $3000. Add to that the library/interpretation costs and one can consider that the

instrument investment will be $14,000 per year over the life of the instrument.

The staffing, training, regulatory and legal requirements are harder to quantify. But they will add cost to the investment. And then one needs to consider down time. Suppose the instrument is not being used. Or the staff member is not fully utilizing their hours. All these are factored into the equation.

ITEM	ONE TIME COST	YEARLY COSTS
INSTRUMENT PURCHASE	15,000 TO 20,000	
ACCESSORY PURCHASE	2,000 TO 5000	
TRAINING	3000 TO 7000	
SERVICE CONTRACT		2000/YEAR
T&M SERVICE		1500 MINIMUM
PM PARTS		1800 /YEAR
SERVICE ON AN AGING INSTRUMENT		$3000/YEAR
COMPUTER AND SOFTWARE	$3000	
TOTAL	23,000 T038,000	2000 TO 3500
LIBRARIES	$20,000	$8000

Conclusion

On the surface, if a company spends $10,000 yearly on outside services using a single technique, then the purchase of a $20,000 instrument seems to make sense. But when you take into account the expenses both tabulated here as financial outlay as well as staff, support, regulatory and legal concerns, the real expense of acquiring an instrument becomes much higher and for a simple instrument could approach $100,000 over the life of the equipment.

A lot of external consulting can be acquired for that $100,000 and it can be directed to the best technique for the job rather than the one that is in-house. Companies that are considering the acquisition of equipment over using contract laboratories need to consider all these factors before investing in complicated and expensive analytical equipment.

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[I] Laboratory Testing Services in the US, August 2011, IBIS World, Santa Monica, CA.
[II] Hanson, D., *Chem &Eng News,* July, 12, 2010.