SAMPLING COLUMN

A tale of two laboratories II: resolution

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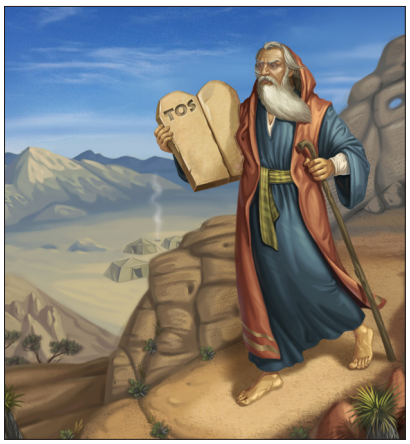
This column completes the tale of two fictional laboratories both facing the issue: "How can the Theory of Sampling (TOS) help the commercial laboratory to improve its reputation and to increase its business"? For decades, Laboratory A has been in fierce market competition with Laboratory B, and indeed several others on the global market, which has resulted in a "healthy" business-oriented science, technology and expertise drive that has served all laboratories well. Both laboratories are keenly aware of the necessity to be in command of TOS for all their in-house activities involving sampling, sub-sampling, mass-reduction and sample splitting. But, whereas Laboratory A has availed itself of the services of TOS strictly within its own regimen only, as is indeed the case for most laboratories, one fine day the manager of Laboratory B had an epiphany that made her see potential advantages of applying TOS in full, which involve a distinctly "beyond-the-traditional-laboratory" scope. What happened? And how did it help Laboratory B to do better in the market?

Scope. In addition to the column author's own take, three other contributors from science, commerce and economics have been asked to give their suggestions on what could possibly have been the contents of Laboratory B head's epiphany? Let's start on the lighter side…

Epiphany interpretation I: knowingly closing one's eyes or not?

"A vision of a white-bearded figure carrying a tablet comes down from the mountain. The CEO can barely make out the writing, but there are the letters 'TOS' at the top … As the figure spoke of primary sampling error effects not taken proper care of, she became terrified at the thought of potential implications for her laboratory … culpability, and the ultimate terror … litigation."

Indeed, starting out on the lighter side, this interpretation turns decidedly serious right away… culpability, litigation… because of what? This can only relate to consequences of decisions made based on the analytical results. Which is why all commercial laboratory analytical reports carry a disclaimer, in one or many other



forms, the contents of which are identical. However, "The analytical results reported here, and their analytical uncertainty, pertain to the samples delivered." For emphasis "…pertain to the *samples* delivered". This disclaimer has the clear aim to absolve the analytical laboratory of legal responsibility regarding any-and-all consequences of decisions made based on the analytical results. Such decisions are made by the client.

Most laboratories (including A and B) are undoubtedly fully aware of the risk of relatively minor sampling errors affecting the Total Analytical Error (TAE) stemming from in-house sub-sampling, sample preparation, mass-reduction etc. in the pathway from "samples received" to analysis. All of which are very seriously taken care of in any commercial laboratory enterprise whose reputation and livelihood are directly associated with the most professional command of all aspects of the science, technology and practise of *analysis*.

But the effects of the dominating primary sampling errors, if/when not taken proper care of (see previous column) are still looming in nowhere land; nobody is willing to take responsibility. The manger realised that the consequences for believing blindly in the analytical report would be borne only be the client.[1]

Epiphany interpretation II: the economic dilemma

"The CEO of Laboratory B realised that a new business opportunity no other laboratory so far had tapped into, would be to encompass the whole process, from lot to aliquot, i.e. taking care of proper counteractions w.r.t. ***both*** *TSE and TAE."*

She felt particularly satisfied to avoid the negative statement: "Primary

sampling is outside Laboratory B's responsibility",[1] being fully aware though, that by identifying this risk element, the largest uncertainty component, Laboratory B would actually demonstrate its deliberate unwillingness to acknowledge the consequences hereof. Which would, therefore, still have to borne by the client alone—yet this risk, and its demonstrably dire economic consequences, are well known. Increasingly, knowledge of these negative effects seems like a burden … …

"Also: increase market share! She was well aware of this challenge, since no one had so far gone the whole way. And she understood the reason. Typically, clients of the laboratory only ask for the result of the aliquot analysis because they need to document the analytical results for **their** *clients in turn."*

A-ha, laboratories often exists in a broader perspective: from-lab-to-client-to-client. As an example, think: analytical laboratory → consulting engineering company (e.g. responsible for environmental surveys) → regulatory authority. There are many other *similar* situations in which the entity responsible for the primary sampling is an *outsourced* entity by the ultimate end-user. In such a case, there is typically no direct communication between the lab and the end-user. The market has *faith* that TAE pertains not only to the laboratory results but also the TSE part—to the degree that this "technicality" is known (which *may* well be to only a very small degree, viz. current experiences). The immediate client of the laboratory has no interest in correcting this, since this would only increase costs unilaterally (in order to start performing representative primary sampling). This is the traditional economic argument.[1]

Of course, in a market economy, companies (commercial laboratories are no exception), each being micro-economic ventures on their own, primarily feel responsible for their own economy. They feel that they **must** look to maximise profit before anything else. So the conventional wisdom goes in the harsh real-world of market economics.

There are two components in this aspiration: increase earnings and/or limiting costs, both defining the gap for profitability. In her dream the CEO felt very sure of being in command of this *narrow*, microeconomic competence—but, of course, just going along as usual was not really the issue…

"Laboratory B CEO's epiphany was a realisation that the whole package TSE + TAE was not ***in demand*** *by the client, because the clients-of-the-client believe this is included already. The CEO realised a critical need for finding tangible, compelling examples of what will happen in case of the omission of TSE, specifically in terms of economic impacts for commerce but also other less directly tangible impacts for the public. It was felt essential to facilitate an efficient awareness (perhaps even public intervention) of these matters, lest 'Sampling… is gambling'!"*

Laboratory B therefore needs also to address the *clients-of-the-client* in creating an **explicit demand** for a more responsible behaviour by the primary laboratory client, and indeed of the laboratory itself. This will require a two-fold exercise i) an *augmented* marketing strategy and ii) becoming involved in fostering *increased awareness* w.r.t. TOS in general, the dire economic effects of continuing to neglect the primary sampling error effects in particular.[2] But, even in her dream trying to break free of traditional bonds, the CEO could hear voices repeating the "board room" argument: why should Laboratory B be the one to accept larger costs for delivering the exact same quality analytical results?

Speaking of dreams, epiphanies, nightmares—the latter often comes in the form of a *dilemma*: "I am doomed (economically) if I undertake larger costs than all of my competitors" and "I am doomed (morally) if I neglect the new insight that neither the client nor the client-of-the-client care one bit whether TSE is included—so long as this is **not known** by the end-user". Clearly, this is an untenable situation in any time perspective.

"What is common to dilemmas is ***conflict****. In each case, an agent regards herself as having moral reasons to do each of two actions, but doing both actions is not possible. Ethicists have called situations like these* ***moral dilemmas****. The crucial features of a moral dilemma are these: the agent is required to do each of two (or more) actions; the agent can do each of the actions; but the agent cannot do both (or all) of the actions. The agent thus seems condemned to moral failure; no matter what she does, she will do something wrong (or fail to do something that she ought to do)".*

Epiphany interpretation III: the moral resolution

There were some powerful statements in the epiphany, almost as if *written in stone*:

i) The client, and the client-of-the-client, *deserves* to know about the risk of severe economic (and other) consequences if neglecting the $TSE_{primary\ sampling}$ effects.

ii) In case this is not known to the client and/or the client-of-the-client, everybody in-the-know, Laboratory B of course included, has a *moral obligation* to rectify this, to fill-in this factual lacuna. It cannot be right deliberately to keep one's client in the dark regarding issues that have a very high

SAMPLING COLUMN

risk of severely influencing its bottom line adversely.

iii) WHAT will happen the day the clients find out about this wilful omission?

iv) Integrity: doing what is right, regardless of whether this is known or not. Integrity is a characteristic that comes from within, based on awareness and knowledge.

The CEO realised that the integrity of Laboratory B was at stake!

The CEO realised that she would rather be CEO of a company with scientific integrity, than continue to avoid a societal and moral obligation, now knowing well the adverse consequences for her company's clients!

The CEO was thus now convinced that *honesty, integrity and transparency* must be the motto for Laboratory B's behaviour in the "analysis for sale" market. This has a necessary corollary obligation for her company. It is critically necessary to partake in a campaign for increased TOS awareness directed at everybody involved. This includes companies where sampling plays a critical role in general (**quite** a few it turned out, after just a few moments' thought) and analytical laboratories specifically (commercial as well as academic).[3] It also includes all relevant entities in society at large, e.g. monitoring and regulatory authorities, department and governmental advisors and agencies, scientific outlets, NGOs.[4]

As but one example of importance, the EFSA (European Food Safety Agency) is charged with safeguarding the public regarding food safety and public health in all of the EU's member states. What would happen if representative sampling was **not** one of its most important priorities? N.B. of course an entity like EFSA has a series of major other obligations and objectives, but many of these would suffer were not proper sampling also taken seriously. Most routine and advanced analytical characterisation of, e.g., food, feed, plants, GMOs…. are completely at the mercy of whether the relevant primary "samples" are indeed representative samples, or not. As all readers of these columns will know intimately, this is of imperative importance and cannot be overlooked without severe risks of adverse consequences, certainly not only of economic character, but infinitely more important, consequences for **public health** in its most broad perspective. What would happen, *hypothetically*, if the European populace one day were to find out that their public health safeguarding is not backed by absolute competence and total diligence? To be absolutely clear, the example of EFSA is *imaginary*, and only used here to focus the perspective, viz. the recently published comprehensive report specifically on sampling.[5]

Laboratory B's new vision and mission

The CEO laid out a new vision and mission for Laboratory B; the following mottos would henceforward now be the message to its customers:

- Laboratory B trusts and supports employees to take personal ownership and accountability, and learn from their experiences …
- Laboratory B is partnering with customers to enhance their productivity and performance …
- Laboratory B is listening to customer challenges and actively anticipating their future requirements …
- Laboratory B will do the right thing even if it means losing business …

In the market place there would be no mercy for a company's reputation, if it was revealed and proved that the company engaged in a willing omission of disclosure and co-responsibility for the primary sampling error dominance w.r.t. the total Measurement Uncertainty ($MU_{sampling + analysis}$). The market would not be kind in the face of: "but we are simply seeking maximise our own profit—in a stark competition".

On the said "fine day" (see previous column), the CEO instigated a vigorous campaign for total scientific and economic responsibility and transparency.[6] Among other initiatives she immediately made contact with appropriate TOS experts and educators in order to collaborate on this new mission. By doing this she was sure of minimising her own costs while maximising the benefits for clients—**and** clients-of-clients.

Can this really lead to increased commercial success?

How can one make sure that one's favourite commercial analytical laboratory, or company producing instrumental analytical equipment and "solutions", observe due diligence w.r.t. the overwhelmingly largest contributor to the **total** Measurement Uncertainty ($MU_{sampling + analysis}$)?

Easy—even a cursory visit to relevant company web sites clearly reveals whether there is the appropriate awareness, or not. The reader is encouraged to do exactly that—and observe which company/companies instil confidence and trust in the mind of the website reader w.r.t. the so-often forgotten critical sampling issue.

The genie is out of the bottle, it is only a matter of who will be the first mover…?[7] Will it be your laboratory?

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