Can we ignore certain relatively small uncertainties?

In the process of evaluating measurement uncertainty of a test method, we come across various uncertainty budgets and obtain a few standard uncertainties for final estimation of its combined uncertainty. The magnitude of each uncertainty component varies and there will be some relatively small uncertain components obtained in the process. In fact, we can ignore some of these relatively small uncertainties without seriously affect the final evaluation.

For example, if we have two components of standard uncertainty in an evaluation, say, u_1 = 0.20, $u_2 = \pm 0.90$, then the combined standard uncertainty

$$u_c = \sqrt{u_1^{\,2} + u_2^{\,2}} = \sqrt{0.20^2 + 0.90^2} = 0.92$$

If we decide to ignore u_1, the combined uncertainty will be simply u_2, i.e. 0.90, and the *relative (or fractional) error E,* in taking 0.90 as the combined uncertainty instead of the actual 0.92 is:

$$E = (0.92 - 0.9) / 0.92 = 0.022 \text{ (or 2.2\%)}$$

Let's consider another example, say $u_1 = 1$ and $u_2 = 1/3$, then the combined standard uncertainty is

$$u_c = \sqrt{1^2 + \left(\frac{1}{3}\right)^2} = 1.05$$

In this case, the fractional error $E = (1.05 - 1.00)/1.05 = 0.048$ (or 4.8%). It means that if we were to ignore an uncertainty component which is 1/3 of another uncertainty component, we would actually incur a marginal error of 5%. The question is : can we afford to ignore this marginal error by not considering this smaller uncertainty budget?

A case in mind is upon considering the magnitude of a sampling uncertainty as compared with the uncertainty in the laboratory analysis. When a population for sampling is quite heterogeneous or not evenly distributed, the random sampling uncertainty can be quite significant. If it is 1/3 or more than the uncertainty in the subsequent analytical process, we can 'safely' ignore the analysis uncertainty and consider the sampling uncertainty alone as it will contribute to more than 95% of the uncertainty evaluation process.